Towards the INMS

International Nitrogen Management System

www.inms.international

Final version of the 'Towards INMS' CEO Endorsement Request, Pro-Doc and Appendices

Document version 29-11-16

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REQUEST FOR CEO ENDORSEMENT

PROJECT TYPE: Full-sized Project

TYPE OF TRUST FUND: GEF Trust Fund

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PART I: PROJECT INFORMATION

Project Title: Targeted Research for improving understanding of the Global Nitrogen Cycle towards the establishment of an International Nitrogen Management System (INMS)			
Country(ies):	Global	GEF Project ID:[1]	5400
GEF Agency(ies):	UNEP	GEF Agency Project ID:	01142
Other Executing Partner(s):	International Nitrogen Initiative (INI) hosted by NERC-CEH	Submission Date:	25 May 2016
GEF Focal Area (s):	International Waters	Project Duration(Months)	48
Name of Parent Program (if applicable): • For SFM/REDD+ ☐ • For SGP ☐ • For PPP ☐	N/A	Project Agency Fee ($):	570,000

A. FOCAL AREA STRATEGY FRAMEWORK[2]

Focal Area Objectives	Expected FA Outcomes	Expected FA Outputs	Trust Fund	Grant Amount ($)	Co-financing ($)
IW 3 Objective: Support foundational capacity building, portfolio learning, and targeted research needs for joint, ecosystem based management of trans-boundary water systems	Outcome 3.4: Targeted research networks fill gaps		GEFTF	6,000,000	56,575,907
Total project costs				**6,000,000**	**56,575,907**

[1] Project ID number will be assigned by GEFSEC.

[2] Refer to the Focal Area Results Framework and LDCF/SCCF Framework when completing Table A.

B. PROJECT FRAMEWORK

Project Objective: To improve the understanding of the global/region N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems						
Project Component	**Grant Type**	**Expected Outcomes**	**Expected Outputs**	**Trust Fund**	**Grant Amount ($)**	**Confirmed Cofinancing ($)**
Component 1: Tools for understanding and managing the global Nitrogen Cycle	TA	Stakeholders, including policy makers, scientists, industry, farmers, business and civil society, have an agreed basis for informed decision making on N cycle management. Stakeholders using agreed assessment and quantification methods to evaluate N cycle status acting as a common basis for regional / global scenarios to guide management actions.	Development of Indicators for assessing full N budgets, use, levels and impacts, including N use efficiency and benchmarking. Indicators would be developed of relevance for specific stakeholders Methodology for threat assessment . Approaches to estimate the value of N threats and benefits of N that are of use to multiple stakeholders groups (including the private sector) Methods for determining N fluxes and distribution of N (water, air, land, agriculture, industry, etc.). Approach to using existing N flux/pathway models for regional assessments and visualisation for potential scenarios to assist with development	GEFTF	1,400,000	24,259,170

			and reduction strategies. Understanding the barriers to change at all levels of society (government, private sector and civil society) including technical, financial and socio-political limitations.			
Component 2: Quantification of N flows threats & benefits	TA	Regional and Global information on N cycle fluxes and impacts, enabling strategies to be implemented to minimise negative effects of excess or insufficient reactive N, while maximising the quantified co-benefits for other sectors including the Green Economy.	Quantification and assessment of the regional threats from excess N and insufficient N Detailed overview of regional/local N flux and consolidation into a global assessment of N fluxes and pathways Consolidation of methods and good practices to address issues of excess and insufficient N_r. Definition of programmes and policy options for improved N_r management at local/regional/global levels, supported by cost-benefit analysis to underpin options for the Green Economy. Compendium summarizing the state of knowledge, experience and measures adopted by	GEFTF	1,680,000	16,402,475

			GEF (and others) gained from addressing the issues of excess and insufficient N_r			
Component 3: Demonstration and verification of management tools at local/national levels (building on existing / planned interventions)	TA	GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised.	3/4 regional/ national/local demonstration activities (that build on existing or planned nitrogen management actions providing catalytic results) deliver conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing: **Case 1:** Challenges and opportunities for developing areas with excess reactive nitrogen. **Case 2:** Challenges and opportunities for developing areas with insufficient reactive nitrogen. **Case 3:** Reactive nitrogen challenges and opportunities for regions with transition economies. **Case 4:** Challenges and opportunities for developed areas with excess reactive nitrogen (using co-financed resources only). Assessment and quantification of impacts from piloting activities to	GEFTF	1,650,000	10,254,630

			reducing negative impacts from poor N_r management, while demonstrating the co-benefits for other issues. Refined benchmarking of indicators for different regions and nutrient flow systems. Plans for inclusion of agreed approach to N cycle assessments in support of the emerging Policy Arena on Nitrogen in engagement with GPA, OECD, UNEA and other bodies.			
Component 4: Awareness raising and knowledge sharing	TA	Local , national and regional expertise to address N_r issues increased and contributes to improved decision making in the Policy Arena on Nitrogen at the regional / global levels Improved access to and sharing of information in cooperation with IW:LEARN. Improved knowledge management with compiled knowledge and experiences about the project shared with other GEF projects and GEF Sec. and accessible on IW:LEARN.	Information sharing and networking portal to assist the GPA, OECD, UNEA, UNECE and other bodies with uptake of understanding of N_r cycle and means to mitigate negative impacts. Training for regional/national experts to sustain and enhance understanding of global N cycle implementation of national indicators, diffusion of new technologies and links across the nitrogen policy arena relevant for inter-governmental processes.	GEFTF	980,000	4,209,632

		Improved project execution from IW Conference participation and the use of the GEF5 IW indicator tracking system.	Overall demonstration of the International Nitrogen Management System (INMS) in support of understanding the Global Nitrogen Cycle to further the objectives of GPA, UNEA, OECD, UNECE and other bodies across the emerging Policy Arena on Nitrogen. 2/3 guidance documents specific to selected private sector stakeholders advising on assessing and presenting nitrogen management and use efficiency issues. Presentation of INMS development to UN Environment Assembly in Yr 2, 3 & 4 With 1% of the project resources in support of IW:LEARN: Dedicated project website connected with IW:LEARN and other GEF knowledge management systems (within 6 months). Docummented cooperation and knowledge exchange			

			with (i) IW:LEARN including at least one functioning CoP as well as (ii) with STAP. Participation at the International Waters conferences; at least 3 experiences notes and tracked project progress reported using the GEF5 IW tracking tool.			
Subtotal						55,125,907
Project management Cost (PMC)[3]				GEF TF	**290,000**	**1,450,000**
Total costs (GEF funding; Co-financing)					**6,000,000**	**56,575,907**
Total project costs						**62,575,907**

C. SOURCES OF CONFIRMED COFINANCING FOR THE PROJECT BY SOURCE AND BY NAME ($) Please include letters confirming cofinancing for the project with this form[4] [5]

[3] PMC should be charged proportionately to focal areas based on focal area project grant amount in Table D below.

[4] Project Partners are here distinguished as: Coordinating Partners (C1..C3), Delivery and Research Partners (D1..D42), Business Sector Partners (B1..B8), Civil Society Partners (S1..S3), Regional Case Study Partners (R1…R33).

[5] TBD indicates partners whose co-financing contributions will be determined during the project. Letters of support have been provided.

Partner involvement	Sources of co-financing	Type	Partner name/Name of co-financier	CASH CO-FINANCING	IN-KIND CO-FINANCING	TOTAL CO-FINANCING
			Partners primarily with global focus in the project			
C1	GEF Agency	Policy support	United Nations Environment Programme	-	1,708,000.00	1,708,000.00
C2	Non-ministry government body	Science and Policy Support	Natural Environment Research Council	1,134,378	3,820,322	**4,954,700**
C3	Others	Science and Policy Support	University of Edinburgh	-	3,500,000	**3,500,000**
D1	Other Multilateral Agency (ies)	Science	Secretariat to the Convention on Biological Diversity			
D2	Other Multilateral Agency (ies)	Policy support	UNECE Conventions on Transboundary Water and Transboundary Air Pollution	-	100,000	**100,000**
D3	Other Multilateral Agency (ies)	Policy support	Organisation for Economic Co-operation and develpment	-	387,000	**387,000**
D4	Other Multilateral Agency (ies)	Science and Policy Support	Food and Agriculture Organization of United Nation	-	1,844,247	**1,844,247**

D5	Other Multilateral Agency (ies)	Science	World Meteorological Organisation	-	-	-
D6	Other Multilateral Agency (ies)	Science and Policy Support	International Institute for Applied Systems Analysis	-	2,000,000	**2,000,000**
D7	Other Multilateral Agency (ies)	Science and Policy Support	European Commissions, Joint Research Centre	-	1,200,000	**1,200,000**
D8	Other Multilateral Agency (ies)	Science and Practices	The Interna tional Maize and Wheat Improvement Center	-	800,000	**800,000**
D9	Non-ministry government body	Science and Policy Support	PBL Netherlands Environmental Assessment Agency	-	1,250,000	**1,250,000**
D10	Non-ministry government body	Science and Policy Support	National Institute for Public Health and the Environment The Netherlands	-	580,000	**580,000**
D11	Non-ministry government body	Science and Policy Support	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	160,000	535,000	**695,000**
D12	Non-ministry government body	Science and Practices	National Institute for Agronomic Research	-	794,000	**794,000**
D13	Non-ministry government body	Science and Policy Support	United States Environmental Protection Agency	-	1,270,000	**1,270,000**
D14	Non-ministry government body	Science and Policy Support	Federal Environment Agency	-	1,352,152	**1,352,152**
D15	Non-ministry government body	Science and Policy Support	French Agency for Environment and Energy Management	10,000	9,000	**19,000**
D16	Non-ministry government body	Science	Consiglio Nazionale delle Ricerche	-	200,000	**200,000**
D17	Non-ministry government body	Science	Norwegian Meteorological Institute	40,000	200,000	**240,000**
D18	Non-ministry government body	Science and Practices	Victorian Department of Economic Development, Jobs, Transport and Resources - Agriculture Division	200,000	300,000	**500,000**
D19	Others	Science and Policy Support	Alterra Wageningen University and Research Centre	3,137,000	1,866,000	**5,003,000**
D20	Others	Science and Policy Support	Wageningen University and Research Centre, Livestock Research	3,286,250	426,250	**3,712,500**
D21	Others	Science and Policy Support	Energy research Centre of the Netherlands	-	1,006,250	**1,006,250**
D22	Others	Science and Policy Support	Vrije Universiteit	-	300,000	**300,000**
D23	Others	Science and Practices	Nederlandse organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek	-	600,000	**600,000**
D24	Others	Science and Policy Support	Potsdam Institute for Climate Impact Research	-	1,470,137	**1,470,137**
D25	Others	Science	University of Bonn	-	330,000	**330,000**

D26	Others	Science and Practices	Leibniz Institute for Agricultural Engineering	-	20,000	**20,000**
D27	Others	Science and Practices	Aarhus University, Department of Bioscience	-	475,000	**475,000**
D28	Others	Science and Practices	Aarhus University, Department of Agroecology	450,000	950,000	**1,400,000**
D29	Others	Science and Practices	Aarhus University, Department of Environmental Science	-	773,600	**773,600**
D30	Others	Science and Practices	Institute of Water Resources Engineering	-	5,500	**5,500**
D31	Others	Science and Practices	Agrophysical Research Institute	-	75,000	**75,000**
D32	Others	Science Support	Institute of Physicochemical and Biological Problems in Soil Science	15,000	35,000	**50,000**
D33	Others	Science and Practices	Instituto Superior de Agronomia (School of Agronomy) of the University of Lisbon	-	258,000	**258,000**
D34	Others	Science and Practices	Ataturk Horticultural Central Research Institute	65,000	40,000	**105,000**
D35	Others	Science and Practices	Fundacao da Faculdade de Ciencias da Universidade de Lisboa, FP	480,000	50,000	**530,000**
D36	Others	Policy support and Practices	Stockholm Environment Institute at York / York University	5,072	2,571,149	**2,576,221**
D37	Others	Science and Practices	University of East Anglia	-	98,000	**98,000**
D38	Others	Science, Practice and Policy Support	North American Nitrogen Center	-	2,100,000	**2,100,000**
D39	Others	Science and Policy Support	New York University	10,000	30,000	**40,000**
D40	Others	Science and Practices	World Resources Institute	-	497,000	**497,000**
D41	Others	Science and Practices	University of Missouri	133,000	295,000	**428,000**
D42	Others	Science and Practices	AgReseach Limited	100,000	450,000	**550,000**
B1	Private Sector/Business	Policy Interest and Practices	Fertilizers Europe	110,300	36,500	**146,800**
B2	Private Sector/Business	Science and Practices	Centre for Plant Nutrition Hanninghof, Yara GmbH & Co.KG, Germany	-	85,000	**85,000**
B3	Private Sector/Business	Science and Practices	BASF SE	-	100,000	**100,000**

B4	Private Sector/Business	Science and Practices	SKW Stickstoffwerke Piesteritz GmbH	-	171,000	**171,000**
B5	Private Sector/Business	Science, Policy and Practices	PigCHAMP Pro Europa S.L.	140,000	260,000	**400,000**
B6	Private Sector/Business	Policy Interest and Practices	International Fertilizer Industry Association	-	100,000	**100,000**
B7	Private Sector/Business	Science and Policy Interest	International Plant Nutrition Institute			
B8	Private Sector/Business	Practices Development	European Agricultural Machinery			
S1	Civil Society Organisation	Policy and Dissemination	Non-governmental organization New Energy	-	15,000	**15,000**
S2	Civil Society Organisation	Policy and Dissemination	World Wide Fund for Nature conservation			
S3	Civil Society Organisation	Policy and Dissemination	Planetary Boundary Initiative			
			Partners primarily with regional demonstration focus in the project			
			CASE 1: Developing regions with excess reactive nitrogen			
R1	Others	Science and Practices	Institute of Soil Science, Chinese Academy of Sciences	100,000	420,000	**520,000**
R2	Others	Science and Practices	National Institute for Agro-Environmental Sciences	30,000	170,000	**200,000**
R3	Others	Science, Practice and Policy Support	China Agricultural University	400,000	100,000	**500,000**
R4	Others	Science and Practices	China Agricultural University	20,000	50,000	**70,000**
R5	Others	Science and Support	Beijing Forestry University	-	300,000	**300,000**
R6	Others	Science and Practices	Zhejiang University	-	500,000	**500,000**
R7	Others	Science and Practices	Chinese Academy of Science, Center for Agricultural Resources Research, Institute of Genetic and Developmental	80,000	320,000	**400,000**
R8	Others	Science and Practices	Field Science Center for Northern Biosphere, Hokkaido University	-	45,000	**45,000**
R9	Others	Science and Practices	Research Faculty of Agriculture, Hokkaido University	-	10,000	**10,000**
R10	Others	Science and Practices	National Institute for Environmental Studies	10,000	10,000	**20,000**

R11	Others	Science and Practices	Kyoto University	3,000	2,000	**5,000**
R12	Multilateral Agency	Policy Support	Partnerships in Environmental Management for the Seas of East Asia			
R13	Others	Science and Practices	Rothamsted Research	300,000	450,000	**750,000**
R14	Others	Science and Dissemination	Society for Conservation of Nature	-	1,150,000	**1,150,000**
R15	Others	Science and Practices	BBRI Bangladesh	-	205,000	**205,000**
R16	Others	Science and Practices	CSIR-National Environmental Engineering Research Institute	-	60,000	**60,000**
R17	Multilateral Agency	Policy Support	South Asia Co-operative Environment Programme			
R18	Others	Science Practices and Policy Support	Earth System Science Centre/National Institute For Space Research	-	1,050,000	**1,050,000**
			CASE 2: Developing regions with insufficient reactive nitrogen			
R19	Multilateral Agency	Science and Practices	International Institute of Tropical Agriculture	-	1,000,000	**1,000,000**
R20	Multilateral Agency	Science Support	Livestock Systems and Environment International Livestock Research Institute	-	350,000	**350,000**
R21	Multilateral Agency	Practice and Policy Support	Lake Victoria Commission Secretariat	123,000	200,000	**323,000**
R22	Others	Science and Practices	Karlsruhe Institute of Technology			
R23	Others	Science and Practices	Ghent University	375,000	275,000	**650,000**
R24	Others	Science and Practices	Laboratoire d'Aérologie Observatoire Midi-Pyrénées	58,000	443,000	**501,000**
			CASE 3: Nitrogen challenges for transition economies			
R25	Others	Science and Practices	Odessa National I. I. Mechnikov University	-	70,000	**70,000**
R26	Others	Science and Practices	Institute of agroecology and environmental management of National Academy of Agrarian Sciences	-	270,000	**270,000**
R27	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution "Institute for Engineering and Environmental Problems in Agricultural	-	115,000	**115,000**
R28	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution "All-Russian Scientific Research Institute for Organic	-	150,000	**150,000**
R29	Others	Science Support	Scientific Research Institute for Atmospheric Air Protection	-	150,000	**150,000**
R30	Multilateral Agency	Policy and Practices Support	Commission on the Protection of the Black Sea Against Pollution	-	-	**-**

			CASE 4: Nitrogen challenges for developed regions with excess reactive nitrogen [without GEF resources]			
R31	Others	Science and Practices	University Pierre and Marie Curie	-		
					200,000	
						200,000
R32	Others	Science and Practices	Technical University of Madrid	-		
					90,000	
						90,000
R33	Others	Science Practices and Policy Support	Centro de Investigaciones Energéticas Medioambientales y Tecnológicas	-		
					106,800	
						106,800
				10,975,000	**45,600,907**	**56,575,907**

D. TRUST FUND RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY[1]

GEF Agency	Type of Trust Fund	Focal Area	Country Name/ Global	(in $) Grant Amount (a)	Agency Fee (b)[2]	Total c=a+b
UNEP	GEFTF	International Waters	Global	6,000,000	570,000	6,570,000
Total Grant Resources				**6,000,000**	**570,000**	**6,570,000**

[1] In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table. PMC amount from Table B should be included proportionately to the focal area amount in this table.

[2] Indicate fees related to this project.

F. CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS:

Component	Grant Amount ($)	Cofinancing ($)	Project Total ($)
International Consultants	176,000	0	176,000
National/Local Consultants	-	-	-

G. DOES THE PROJECT INCLUDE A "NON-GRANT" INSTRUMENT? No

(If non-grant instruments are used, provide in Annex D an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF/NPIF Trust Fund).

PART II: PROJECT JUSTIFICATION

A. DESCRIBE ANY CHANGES IN ALIGNMENT WITH THE PROJECT DESIGN OF THE ORIGINAL PIF[6]

A.1 National strategies and plans or reports and assessments under relevant conventions, if applicable, i.e NBSAPs, national communications, TNAs, NCSA, NIPs, PRSPs, NPFE, Biennial Update Reports, etc

N/A

A.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities.

N/A

A.3 The GEF Agency's comparative advantage:

N/A

A.4. The baseline project and the problem that it seeks to address:

The broad baseline and the problem the project addresses are unchanged. However the context of the baseline has developed and the means (outputs, components) have evolved in the Project Preparation Grant phase in the following main ways since the PIF was submitted:

Component 1: Several groups have already started working on refining indicators related to nitrogen use efficiency (OECD, TFRN, GPNM, EU-NEP) increasing the amount of baseline information, while UK co-financing (NERC International Opportunities Fund, 'INMS Pump Priming Project') allowed an additional workshop to further prepare on the needs for nitrogen integrated assessment modelling. This work has complemented the PPG activity.

PIF Component	Change	Justification
1	The title of the Component has been adapted to: *Tools for understanding ~~to apply methods for understanding~~ and managing the global Nitrogen Cycle*	Improvement in the English
1	The title of Output 1.1 has been adapted to: *Development of Indicators for assessing full N budgets, use, levels and impacts, including N use efficiency and benchmarking. Indicators*	Shortened to streamline long heading

[6] For questions A.1 –A.7 in Part II, if there are no changes since PIF and if not specifically requested in the review sheet at PIF stage, then no need to respond, please enter "NA" after the respective question.

PIF Component	Change	Justification
	would be developed of relevance for specific stakeholders ~~(e.g. private sector – fertilizer prodcuers)~~	
1	The title of Output 1.4 has been adapted to: *~~Development of tools for valuation of the~~ Approaches to estimate the value of N threats and benefits of N that are of use to multiple stakeholders groups (including the private sector)*	Amended to emphasize meeting the needs of multiple stakeholder groups, with private sector specifically added to respond to GEF Sec request.

Component 2: Increased recognition has been achieved through partner activities (e.g. with TFRN, European Union, OECD) of the need to develop joined up approaches for nitrogen management and mitigation technologies that deliver win-wins for water, air, climate etc simultaneously. Additional funding agreement from the European Commission will already support a workshop on this topic in Summer 2016.

PIF Component	Change	Justification
2	The title of Component 2 has been adapted to: ~~Regional / global~~ *Quantification of N ~~use~~ flows, ~~impacts, and the quantitative~~ threats & benefits ~~of applying best management practices~~*	

Component 3: The INMS PPG activities have allowed further development of the co-financing opportunities for the INMS regional demonstrations, with several new funding proposals being written specifically to provide planned support to INMS over the next years. For example, these include NitroPortugal (EU twinning project), NEWS India-UK (Newton-Bhabha Fund between BBSRC and Department of Biotechnology of India), CINAG and NCYCLE (Newton Fund between BBSRC and Chinese Government). As these project are very new, it has not yet been possible to include the cofinancing in the tables. However, these four projects already represent an additional co-financing of over 15M USD cash contribution. Subject to agreement with partners, it is anticipated that it will be possible to report this (and other future projects) as additional co-financing during the project execution phase, over and above that already committed and shown in the tables.

PIF Component	Change	Justification
3	The full title is retained: *Regional Demonstration of Full Nitrogen Approach and verification of management tools at local/national levels (building on existing/planned interventions)* However, in the tables a short title is also used: "*Regional demonstration of the full nitrogen approach*"	A more economical title summary was needed for the tables.

Component 4: Work during the PPG phase has further developed the thinking behind policy homes for INMS compared with the PIF. This is summarized in the baseline description of the Project Document (ProDoc). The latest thinking emphasizes the need not just to engage with GPA, but also with other international policy frameworks, such

as LRTAP, CBD, UNFCCC, Vienna Convention (Montreal Protocol), CSD and others. In particular, UNEA and OECD may be able to play a role in catalyzing the developing concept of the 'nitrogen policy arena', which would serve to join up N interests and strategies, thereby supporting delivery for each of these conventions and programmes.

In order to address comments of the reviewers, minor changes to the apportioning of GEF finance between Components 1, 2, 3 and 4 since PIF stage have been made, as detailed in Annex B2.

A.5. Incremental /Additional cost reasoning: describe the incremental (GEF Trust Fund/NPIF) or additional (LDCF/SCCF) activities requested for GEF/LDCF/SCCF/NPIF financing and the associated global environmental benefits (GEF Trust Fund) or associated adaptation benefits (LDCF/SCCF) to be delivered by the project:

N/A

A.6. Risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and measures that address these risks:

See section 3.6 of the Proposal Document.

A.7. Coordination with other relevant GEF financed initiatives

The work will be conducted to ensure maximum synergy with existing programmes on international environmental governance, such as GPA, CBD, UNECE, OECD and others (e.g. SACEP, PEMSEA, LVBC etc).

B. ADDITIONAL INFORMATION NOT ADDRESSED AT PIF STAGE:

B.1 Describe how the stakeholders will be engaged in project implementation.

The project includes a broad approach to stakeholder engagement as outlined in the table below:

Stakeholder group	Examples	Engagement in project execution
Nitrogen consumers and local managers	All citizen depend on nitrogen for food, energy and transport. The project is relevant both to members of the public and local managers (e.g., farmers, conservation managers, planners)	Local managers will be engaged through the regional demonstrations, including local case studies of Component 3, while communication activities in Component 4 will engage the wider public, building on established foundation with INI including press engagement.
Private sector	The major private sector interests are fertilizer manufacturers and nitrogen users in agriculture (e.g., farmer groups). Businesses involved in nitrogen innovation also have prospect to become more important.	Fertilizer manufacturer companies and business organizations are involved at global and regional scales, including in indicator refinement (Component 1). Farmer organizations are engaged as stakeholders through the regional demonstrations (Component 3). Links with nitrogen innovators (e.g. agricultural engineering, nutrient recovery and reuse, NO_x capture and utilization will be further developed during the project.
Science and academia	As a targeted research project on the global nitrogen cycle the project is prepared under the lead of the International Nitrogen Initiative (INI), including a wide range of academic partners globally.	Partners of the International Nitrogen Initiative (INI) are involved in all components, especially utilizing the INI Regional Centers (East Asia, South Asia, Latin America, Africa, Europe and North America), which provide the basis to implement the Regional Demonstrations of Component 3.
International	Given the wide relevance of the nitrogen	IGOs contribute a wide range of roles in the project, bringing underpinning

Governmental Organizations	cycle several key IGOs are included: UNEP, FAO, WMO, OECD, UNECE, CGIAR (including ILRI, IITA), IIASA	expertise, information on practices, datasets needed for modelling and access to policy communities, including governments.
Policy and decision-making	GPA, CBD, UNEA, UNECE (LRTAP and Water conventions), UNFCCC, Montreal Protocol, Regional Seas Conventions.	Engaged at global and regional scales through development of scenarios, policy options and anticipated benefits (Components 2 and 3). Component 4 will serve to develop wider dissemination and networking beyond the project partnership.

With around 80 partner organizations, 'Towards INMS' already includes a large diverse set of stakeholders. Nevertheless, this is a continually developing area, where the project has adopted the following approach:

a) Incorporating well-established partnerships with stakeholders, including those who have been involved in the original conception of 'Towards INMS' (pre PIF stage).
b) Developing partnerships with stakeholders during the PPG phase, specifically to widen the scope of the project activity.
c) Forging new partnerships, including those that will continue to be developed during the life of the project. In such cases contacts so far have served to provide initial introductions, which will become stronger as groups are invited to engage in execution of the INMS Activities.

B.2 Describe the socioeconomic benefits to be delivered by the Project at the national and local levels, including consideration of gender dimensions, and how these will support the achievement of global environment benefits (GEF Trust Fund/NPIF) or adaptation benefits (LDCF/SCCF):

As a GEF Targeted Research Project, the main emphasis of 'Towards INMS' is to demonstrate how better scientific and technical understanding, combined with implementation of joined up approach to the global nitrogen cycle for the first time, can catalyze a transformational change in governments, business and citizens towards better and more sustainable environmental stewardship. Until now, the consequences of human impact on the nitrogen cycle have been addressed in a fragmented way, where fragmented science has been followed on by fragmented policies, for example, addressing the different source/management sectors and the many benefits and threats separately. It is expected that this separation and lack of policy coherency will contribute substantially to the barriers-to-change to improved conditions for transboundary waters, as well as for air, climate and ecosystems at the same time.

In order to mobilize the necessary change, a large scale approach is needed that brings the science disciplines together with the main stakeholders in order to build consensus on the needs for and benefits of a more joined up approach across the global nitrogen cycle. Key outcomes of the project will contribute the necessary building blocks to effect this change. They include: a) provision and agreement of the new kinds of indicators and tools needed (Component 1), b) demonstrating the large scale global picture of threats and opportunities (Component 2, including a high profile consolidated global assessment that can mobilize the world's press, together with practical guidance on the best management options and future scenarios), c) demonstrating how the approach can operate at regional and local scales, building ground-level support for change (Component 3) and d) knowledge-sharing and wider dissemination to raise the profile of the nitrogen opportunity with governments and citizens globally.

In this way, the Targeted Research approach of GEF through 'Towards INMS' will provide the foundation for transforming to a world that pays increasing public attention to better management of the nitrogen cycle, with an increased understanding of the benefits of doing so. In turn, this will lead to the actual socio-economic benefits on the ground, resulting from a more optimized global nitrogen cycle: a) better availability and access to nutritious food, b) improved renewable energy supply through bioenergy sources, c) cleaner water, especially in the coastal zones, but also in freshwater systems, improving livelihoods, environmental quality and well-being, d) improved air quality, with reduced adverse effects of reactive nitrogen on human health, e) reduced greenhouse gas emissions, especially of nitrous oxide, mitigating climate change threats, while at the same time reducing stratospheric ozone depletion with human health benefits, f) reduced threats on ecosystems and biodiversity from nitrogen deposition leading to a more sustainable natural environment that enriches quality of life and stewards genetic resources for the future, g) healthier soils, as a foundation both for environment and food sustainability in the future. These activities therefore also clearly link with the UN Sustainable Development Goals (especially SDGs 1, 2, 3, 6, 7, 8, 9, 11, 12, 13, 14, 15), to which further links will be made during the project.

Further consideration of these issues is given in the incremental cost analysis, in section 3.8 of the Project Document (and Appendix 3).

Gender issues are relevant for the project in the INMS East African Demonstration (Component 3), where women play a key role in agricultural production and better education of women can substantially enhance improved nitrogen management. These issues will be addressed in this demonstration by close cooperation with the Millenium Villages Project, which has specifically targeted the gender question. The concerns of indigenous peoples will be addressed should they be encountered, but have not so far been raised during the PPG phase as being a priority concern of relevance to this project for the demonstration areas selected.

B.3. Explain how cost-effectiveness is reflected in the project design:

The 'Towards INMS' project provides a highly cost-effective means to address the challenge to provide better understanding of the global nitrogen cycle towards meeting improved environment, food and energy goals. The focus is very much on developing a catalytic approach where common concerns are brought together as a basis to develop a strong central vision, i.e. that joining up across the global nitrogen cycle will deliver many simultaneous benefits that help overcome the barriers to change for cleaner water, fresher air, less climate change, protected biodiversity and improved soil quality, while helping to feed, warm and transport the world in a more sustainable and profitable way.

The strength of this vision and the great cost-effectiveness of the 'Towards INMS' approach is clearly reflected in the gravity of the partnership, with around 80 partners already committed to the project. In terms of co-finance, the total project value already exceeds 10 times the GEF contribution, and the indications are that both the cash co-financing and the contributions-in-kind will continue to grow through the project execution phase (see A.4).

This cost-effectiveness is achieved in the project design by careful attention to recognize the main stakeholder needs for an International Nitrogen Management System. In this way, a wide diversity of government organizations, academic partners, companies and business organisations, as well as regional stakeholders and civil society groups, have demonstrated their enthusiasm to work together.

C. DESCRIBE THE BUDGETED M &E PLAN:

The project will follow UNEP standard monitoring, reporting and evaluation processes and procedures. Substantive and financial project reporting requirements are summarized in Appendix 8 of the Project Document. Reporting requirements and templates are an integral part of the UNEP legal instruments to be signed by the executing agency (CEH on behalf of INI) and UNEP. For the purposes of M&E activities (and the reading of this document), the Project Co-ordinator will function under the direct supervision and control of the Project Director to fulfil the M&E needs.

The project M&E plan, is consistent with the GEF Monitoring and Evaluation policy. The Project Results Framework presented in Appendix 4 includes Specific, Measureable, Achieveable, Relevant and Time-bound (SMART) indciators and targets for each expercted outcome. These indicators along with the key deliverables and benchmarks included in Appendix 6 will be the main tools for assessing project implementation progress and whether project results are being achieved. The means of verification and the costs associated with obtaining the information to track the indicators are summarized in the tables at the end of this appendix (sections 4 and 5 of this appendix). M&E related costs arepresented and are fully integrated in the overall project budget.

The M&E plan will be presented to the first meeting of the Project Management Board (PMB) to ensure project stakeholders understand their roles and responsibilities vis-à-vis project monitoring and evaluation. The (PMB) will be responsible for proposing to UNEP management any necessary amendments to the M&E plan during project implementation. Indicators and their means of verification may also be fine-tuned by the PMB. Day-to-day project monitoring is the responsibility of the PCU but other project partners will have responsibilities to collect specific information to track the indicators. It is the responsibility of the Project Co-ordinator to inform UNEP of any delays or difficulties faced during implementation so that the appropriate support or corrective measures can be adopted in a timely fashion.

The PMB will receive periodic reports on progress and will make recommendations to UNEP concerning the need to revise any aspects of the Results Framework or the M&E. Project oversight to ensure that the project meets UNEP and GEF policies and procedures is the responsibility of the UNEP Task Manager. The Task Manager will also review the quality of draft project outputs, provide feedback to the project partners, and establish peer review procedures to ensure adequate quality of scientific and technical outputs and publications.

The UNEP Task Manager will develop a project supervision plan at the inception of the project, which will be communicated to the project partners during the first meeting of the PMB. The Project Co-ordinator will also be responsible for initial screening of the financial and administrative reports from the core partners prior to their submission to the Finance and Management Divisions of the United Nations Office at Nairobi. Progress vis-à-vis the delivery of agreed project outputs will be assessed by the PMB and endorsed by the Project Partners Assembly (PPA) at least annually. Project risks and assumptions will be regularly reviewed both by project partners and the PCU on behalf of UNEP. Risk assessment and rating is an integral part of the annual Project Implementation Review (PIR), preparation of which will be the responsibility of the Project Manager. The quality of project monitoring and evaluation will be reviewed and rated as part of the PIR, which will be approved by the PMB. Key financial parameters will be monitored quarterly to ensure cost-effective use of financial resources.

A Mid-term Review (MTR) or Mid-term Evaluation (MTE) will be organized by the UNEP Evaluation Office or the Task Manager in consultation with the Project Co-ordinator and the outcomes reported to the to the Project Management Board. The review/evaluation will include all parameters recommended by the GEF Evaluation Office for terminal evaluations and will verify information gathered through the GEF tracking tools, as relevant. The purpose of the Mid-Term Review (MTR) or Mid-Term Evaluation (MTE) is to provide an independent assessment of project performance at mid-term, to analyze whether the project is on track, what problems and challenges the project is encountering, and which corrective actions are required so that the project can achieve its intended outcomes by project completion in the most efficient and sustainable way. In addition, it will verify information gathered through the GEF tracking tools. The review will be carried out using a participatory approach whereby parties that may benefit or be affected by the project will be consulted. Such parties were identified during the stakeholder analysis (see section 2.6 of the project document). The Project Management Board will participate in the mid-term review/evaluation and develop a management response to the evaluation recommendations along with an implementation plan. It is the responsibility of the UNEP Task Manager to monitor whether the agreed recommendations are being implemented.

An independent terminal evaluation (TE) will take place at the end of project implementation. The Evaluation Office (EO) of UNEP will manage the terminal evaluation process. A review of the quality of the evaluation report will be done by EO and submitted along with the report to the GEF Evaluation Office not later than 6 months after the completion of the evaluation. The TE will provide an independent assessment of project performance (in terms of relevance, effectiveness and efficiency), and determine the likelihood of impact and sustainability. It will have two primary purposes:

- to provide evidence of results to meet accountability requirements, and
- to promote learning, feedback, and knowledge sharing through results and lessons learned among UNEP and executing partners.

While a TE should review use of project funds against budget, it would be the role of a financial audit to assess probity (i.e. correctness, integrity etc.) of expenditure and transactions.

Indicative terms of reference for the terminal evaluation are included in Appendix 11. These will be adjusted to the special needs of the project.

The TE report will be sent to project stakeholders for comments. Formal comments on the report will be shared by the EO in an open and transparent manner. The project performance will be assessed against standard evaluation criteria using a six point rating scheme. The final determination of project ratings will be made by the EO when the report is finalised. The evaluation report will be publically disclosed and will be followed by a recommendation compliance process.

The GEF tracking tools are attached as Appendix 14. These will be updated at mid-term and at the end of the project and will be made available to the GEF Secretariat along with the project PIR report. As mentioned above the mid-term and terminal evaluation will verify the information of the tracking tool.

Indicative M&E activities and responsibilities are shown below. Further details can be found in Appendix 7.

TABLE 8: INDICATIVE M&E ACTIVITIES AND RESPONSIBILITIES

Type of M&E activity	Responsible Parties	GEF Budget US$	Time frame
Project Management Board & Project Partners Assembly Inception Workshops	Project Coordinator PCU PMB UNEP Task Manager Project Partners Assembly provides endorsement	38,000	1st PMG and PPA Meetings will serve as Inception workshop and will be held within first four months of project start up.
Inception Report	Project Coordinator PCU	None	Immediately following inception workshop

	PMB UNEP Task Manager Project Partners Assembly provides endorsement		
Measurement of indicators set in the Project Results Framework (Project Progress and Performance to be measured on an annual basis)	UNEP Task Manager Project Coordinator in collaboration with PCU	None	Annually prior to APR/PIR and to the definition of annual work plans
APR and PIR	Project Coordinator & PCU UNEP Task Manager PMB	None	Annually
Periodic status reports	PCU	None	To be determined by PCU, UNEP and EAs
Technical reports/Project publications	For previously agreed reports: Component, Activity and Task Leaders as appropriate For new reports: PMB, Component, Activity & Task Leaders, Hired consultants as needed	95,950	To be determined by Project Team, UNEP and PCU, EA
Mid-Term Review	Project Coordinator & PCU UNEP Task Manager Project Partners Assembly provides endorsement External consultant	20,000	Halfway through project cycle
Terminal External Evaluation	Evaluation Office PCU UNEP Task Manager Project Partners Assembly provides endorsement External Consultants	30,000	At the end of project implementation
Terminal Report	PCU PMB UNEP Task Manager Project Partners Assembly provide endorsement External Consultant*	38,000	At least one month before the end of the project
Lessons learned	PCU UNEP Task Manager Partner executing agencies*	None	Yearly as part of the APR
Audit	UNEP Task Manager PCU EA accredited Auditor	4,000	Yearly
TOTAL indicative COST		224,500	

PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

A. Record of Endorsement of GEF Operational Focal Point(s) on Behalf of the Government(s):): (Please attach the Operational Focal Point endorsement letter(s) with this form. For SGP, use this OFP endorsement letter).

N/A

Name	Position	Ministry	Date *(MM/dd/yyyy)*

B. GEF AGENCY(IES) CERTIFICATION

This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for CEO endorsement/approval of project.					
Agency Coordinator, Agency Name	**Signature**	**Date *(Month, day, year)***	**Project Contact Person**	**Telephone**	**Email Address**
Brennan Vandyke, Director, GEF Coordination Office, UNEP			Isabelle Van der Beck	+1-202-974-1314	Isabelle.vanderbeck@unep.org

ANNEX A: PROJECT RESULTS FRAMEWORK (either copy and paste here the framework from the Agency document, or provide reference to the page in the project document where the framework could be found).

Please see Appendix 04 of the project document

ANNEX B: RESPONSES TO PROJECT REVIEWS (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF).

	GEF Secretariat Comment at PIF	**Response**
	Question 6: Is (are) the **baseline project(s),** including problem(s) that the baseline project(s) seek/s to address, sufficiently described and based on sound data and assumptions?	
1	SHansen (10.04): Prior to CEO endorsement please do provide a more detailed description of the policy options for track 1. This includes the criteria for an appropriate science based policy and advisory system.	The policy options are discussed in section 3.1 of the Project Document. In order to satisfy business stakeholders, it has been emphasized that the role of INMS focuses on Track 2. Conversely, Track 1 is the role of governments. Nevertheless, the discussion highlights how INMS is stimulating governments to consider their options under Track 1. The relationships between the three different tracks (Track 1: policy, Track 2: science; Track 3: practices application) have been considered in depth in Appendix 19 of the documentation, which identified the different criteria and options.
2	Further, and as pointed out in the STAP comments, the GPA has been assumed as the de facto arrangement. This should be analysed further in the project preparation phase, with a view to either identifying additional options, and/or providing greater focus on what is needed in the policy institution(s).	The analysis has been conducted based on wide discussions prior to and during the PPG phase. The key messages of this analysis related to ‘policy homes’ of INMS are included in section 3.1 of the Project Document. In addition, the analysis is being extended in the form a draft paper (**Appendix 20**) for submission as a peer review article This will be used to stimulate further discussions with stakeholders during the implementation of the INMS project to guide the

	GEF Secretariat Comment at PIF	Response
		recommendations on the most appropriate future mechanism(s) for INMS. From the analysis described in Appendix 20 it should be clear that GPA is not automatically the default arrangement and that the emerging conclusion points towards the development and strengthening of an emerging 'nitrogen policy arena'. This concept has recently been advanced by a joint workshop of the OECD and TFRN which provided an additional opportunity for validation of the INMS plan.
	Question 7: Are the components, outcomes and outputs in the **project framework** (Table B) clear, sound and appropriately detailed?	
3	SHansen (1.15.2014): By CEO endorsement please revise the heading belonging to component 3 along the lines of: "Demonstration and verification of management tools at the local / national levels (building on existing or planned interventions)"	As requested, the revised Component 3 heading now clearly emphasizes that the regional demonstration activities "build on existing and planned interventions". This also reflects the reality that each of the regional demonstrations has been selected based on criteria that includes further developing existing and planned activities (See criteria for selection in Appendix 17).
	Question 10: Is the role of public participation, including CSOs, and indigenous peoples where relevant, identified and explicit means for their engagement explained?	
4	(April 26) Prior to CEO endorsement please provide a description of how public participation, CSOs and indigenous peoples will be involved in the demonstration activities.	Each of the regional demonstrations is designed to work with a broad stakeholder group, including public participation and CSOs according to regional relevance. The specifics of each of the GEF funded regional demonstrations are described in Appendices 17a to 17d. The extent to which these issues can be

	GEF Secretariat Comment at PIF	Response
		addressed in the unfunded demonstration is described in Appendix 17e. In addition, the regional demonstrations will engage with Component 4 which specifically addresses dissemination and public engagement. Issues connected with indigenous peoples have not been found to be a key concern for the demonstration regions selected.
	Question 11: Does the project take into account potential major risks, including the consequences of climate change, and describes sufficient risk mitigation measures? (e.g., measures to enhance climate resilience)	
5	April 26) Taking into consideration that the project is global relevant risks has been pointed out (mainly relating to proper scientific collaboration and not least a fruitful transference of assessments to the relevant political level). These risks should be further elaborated prior to CEO endorsement.	The risks associated with human management of the nitrogen cycle including for food and energy, water, air, climate, ecosystems and soils have been further elaborated in the baseline description (especially Section 2.2 to 2.4 of the Project Document).
6	SHansen (10.04): The overall budget for component 3 has been reduced (1.8 to 1.5 mio USD from GEF resources with 160 K USD moved to component 2 to dev. the compendium and 140 K USD to component 4 to strenghten the engagement of stakeholders at all levels (in response to STAP comments)). However, incufficient outreach is still considered a major risk. Therefore, and as pointed out in previous comments, by CEO endorsement please do provide a more detailed description as to how this complex message will be communicated to key stakeholders.	A detailed description of the importance of managing the nitrogen cycle is incorporated in the Project Document (Sections 2.1-2.2), with additional resources allocated to Component 4 (Activity **4.1 & 4.5**) to allow further distillation of the key messages. At present these messages focus on a) emphasis of the win-win environmental opportunities linking across the nitrogen cycle, b) business case for action, by improved resource use efficiency for nitrogen, c) opportunity for N approach to help overcome barriers-to-change. Additional resources have also been allocated to Component 3 (from 1.50 M to 1.65M) to strengthen regional/national/local pubic engagement.

	GEF Secretariat Comment at PIF	Response
		Further refinement of developing the simple messages has continued during the PPG phase, most recently in the joint workshop of OECD and TFRN (May 2016) and in preparation for the OECD Environment Ministers' Workshop. Such high-level interventions will continue in the Implementation phase of the project and with strong press coverage will be critical to both addressing the risks and raising the public profile of the nitrogen issue.
7	(April 26) -Prior to CEO endorsement please elaborate on the mitigation strategy regarding country-buy-in: how will the project ensure a representative buy in from e.g. farmer's organizations?	As outlined in the Project Document and above, this issue is addressed by: a) emphasizing the resource efficiency opportunities for business (e.g. improving nitrogen use efficiency saves farmers money) and b) emphasizing the win-win opportunities of a more joined up approach across the nitrogen cycle. In practice, this means not only focusing on the performance of indicators related to environmental threats, but also addressing indicators that link reduced pollution with increased business performance (such as variants of nitrogen use efficiency). Experience during the PPG phase has already shown that this strategy is developing buy-in by many types of organization including countries, international organizations and business groups. The most proactive business sector has been the fertilizer manufacturers and large agricultural technology companies, as illustrated by their engagement as project partners. Farmer organizations tend to be

	GEF Secretariat Comment at PIF	Response
		both more regionally based, and the focus here is on building partnerships through Component 3 at the regional / national scale.
	Question 13: Comment on the project's **innovative aspects, sustainability, and potential for scaling up**. • Assess whether the project is innovative and if so, how, and if not, why not. • Assess the project's strategy for sustainability, and the likelihood of achieving this based on GEF and Agency experience. • Assess the potential for scaling up the project's intervention.	
8	SHansen (10.04): Prior to CEO endorsement please do provide a convincing description of the future sustainability of the INMS, e.g. who will fund the INMS beyond the current project period (network of scientific institutions etc.).	Please see response 2. In essence, the longer term sustainability of INMS will depend on building wide recognition of the value of the approach, especially through engagement with countries through the developing 'nitrogen policy arena'. Specific resources are reserved to further develop this engagement through Component 4.
	Question 16: Is the GEF funding and co-financing as indicated in Table B appropriate and adequate to achieve the expected outcomes and outputs?	
9	(April 26) By CEO endorsement please do address the points in the baseline (box 6) and components, outcomes and outputs (box 7) in order to evaluate the appropriateness of GEF funding.	Addressed in Project Document Sections 3.3 and 3.4 on project components/activities and incremental cost analysis respectively.
	Question 24: STAP Review	
10	'*Please be aware that a review of the draft final targeted research prodoc by a STAP Advisory Science Committee prior to CEO endorsement stage is both desirable and likely. UNEP will be kindly asked to plan accordingly and allow appropriate time before endorsement (at least a month before endorsement plus give an early "heads-up" to STAP to allow for timely constitution of the advisory science committee).*	UNEP consulted with the STAP. The STAP Secretary however stated that in line with policy GEF STAP C.43 Info 02, STAP would not review the CEO endorsement documents. STAP engagement on Targeted Research projects will be consistent with recommendation 5 (see below for ease of reference. The PIF was however extensively reviewed by a panel of two experts recruited by the STAP and STAP considers this sufficient.

Comments from STAP

<table>
<tr><th>STAP Comment at PIF</th><th>Response</th></tr>
<tr><td>3. During project preparation there should be a continued focus on "change agents" amongst the different stakeholders concerned about the information and tools to be provided in the INMS. Such a distinction and future work on providing real value add in terms of tools will be critical beyond the relevant policy aspects that are in the domain of "countries".</td><td>The project preparation phase has included a strong attention to ‘change agents’ among the different stakeholder, in particular:
Seeking to build partnerships with financing bodies to deliver the necessary critical mass well beyond the GEF contribution
Seeking to build partnerships with ‘nitrogen champions’, working to raise the nitrogen issue from official level to senior official level and ministerial level, allowing ministers to act as key ‘agents for change’
Utilizing a diversity of inter-governmental frameworks to mobilise interest in and support for a joined up nitrogen approach, including OECD, UNECE, CBD, GLOC.
Building on established press engagement by use of novel ideas positioning nitrogen in the public mind (e.g. see selection of press articles stimulated by the PCU in The Times, Economist, BBC etc during PPG phase – See Appendix 21)</td></tr>
<tr><td>4 Considering the very large numbers of participating organisations in the proposed project a project component 5 should be carefully designed that address project implementation, monitoring and evaluation. Project implementation and M&E will be an important component of this project to ensure clear guidance to partners and to synthesize the learning from the different components and actors involved. The formation of the Scientific and Policy Advisory Group SPAG) is welcomed. The planned participation of a range of concerned stakeholders in the SPAG should ensure that the results of the projects are useful to different "change agents". STAP further advises that a strong ICT strategy is developed as part of this component. This goes</td><td>The INMS PPG team considered the need for an additional component but have opted to have the M&E activities embedded in the four existing components to ensure a close linkage between the monitoring/evaluation and management response.

As emphasized above, Component 4 is designed to facilitate the learning and dissemination process, and develop strong links with the GEF IW:LEARN to ensure that results are available to GEF IW projects and more widely (through the partners existing links with other fora).

The size of the partnership (c.80 organisations providing co-finance) necessitates the use of a ‘Project Partners Assembly’ as a means to engage all partners/stakeholders. This will provide an opportunity for this broad partnership (private sector, NGOs, international</td></tr>
</table>

STAP Comment at PIF	Response
beyond a project website linked to IW Learn and could include clear strategies on online communication tools amongst the partners (visualization, voice, video and written texts) and joint data repositories using "cloud" technology.	organisations, etc.) to engage in discussion on the direction and results of the INMS project. An early output from Component 4 will be the finalization of a communication strategy that will identify innovative communication approaches to convey the results and recommendations to a wide range of policy-maker-to-practitioner stakeholders. For example, parallel co-financing (through the NEWS India-UK project will allow the trialing of a first Massive Online Open Course – N-MOOC) as a contribution to the developing INMS dissemination strategy.
5. The future global institutional ownership of the INMS should be discussed during project preparation and resolved during project implementation.	As discussed above (GEF Response 2) this is addressed in Section 3.1 of the Project Document, supported by a paper in preparation for publication in a peer review journal to further stimulate this discussion with governments, science community, press, business, CSOs and others.

Comments from Council Members

Council Comments at PIF	Response
Germany approves the following PIF in the work program but asks that the following comments are taken into account: Suggestions for improvement to be made during the drafting of the final project proposal: UNDP is attempting to improve the available data and management options regarding nitrogen cycle. The scheme encompasses about 100 partner organizations and $6 million of funding and planned co-financing of $47 million within 4 years. To our knowledge there are no cases where opportunity costs for lost fishery revenues or lost tourism revenues were outweighed by investment costs into the prevention of coastal dead zones. However, the benefits of the activity are probably in linking different actors, mainstreaming, and public awareness campaigns. • Germany approves the project proposal, but recommends a stronger focus on the mentioned plan to raise public and political support.	The proposers of 'Towards INMS' note the observations from Germany and the recommendations to strengthen the 'outreach' is noted in Component 4 and by active engagement in policy discussions. This has already been reflected in the PPG phase by active support from the PPG phase towards the German Nitrogen Strategy in meetings in Germany, through UNECE and OECD. This is illustrative of how INMS is working with champion countries such as Germany to mobilize action on the nitrogen challenge.
The **United States** requests that the UNEP modify the project prior to GEF CEO Endorsement in accordance with our technical comments. The United States recognizes that excess nitrogen is one of the most significant global pollutants, especially in coastal and marine ecosystems. This proposal is technically strong and the proposed project components have received significant support from the global scientific community including the GEF STAP. Nonetheless, the United	The proposers of 'Towards INMS' take note and appreciate the comments from the United States on the technically strong proposal. The proposal has been submitted as a *Targeted Research* Project and as such does indeed address the research needs associated with identifying and quantifying pathways of reactive nitrogen balanced by a practical approach to testing methods through regional pilots. We understand that any proposal to change the project name would need to be agreed with GEF Secretariat. The proposers are open to

Council Comments at PIF	Response
States believes the GEF should be cautious about supporting projects that have a significant research focus. At the same time, the project components included in this proposal (ie: tool development; quantification of nitrogen use flows and impacts; demonstration and verification of management tools; knowledge sharing / information management and capacity development) are required to facilitate future mitigation of reactive nitrogen on ecosystems and therefore we do not consider them research. For this reason, we recommend that the project title be modified to include the other aspects of the project proposal.	refine the project title if the GEF agrees that this would be useful. For example, an option could be: "Targeted Research, **tools and capacity development** for improving understanding of the Global Nitrogen Cycle towards the establishment of an International Nitrogen Management System (INMS)."

ANNEX B.2: JUSTIFICATION FOR CHANGES TO BUDGET AND STRUCTURE

The overall structure remains unchanged from the PIF, while only minor budget changes have been made to strengthen delivery of the project in responding to the reviewers' comments:

Component 3: Increased GEF resource from 1.5 M USD to 1.65 M USD to strengthen stakeholder, farmer and public engagement in the regional demonstrations (response to GEF Secretariat Review Comments 6 and 7).

Component 4: Increased resource from 0.94M USD to 0.98 M USD to strengthen stakeholder, farmer and public engagement (response to GEF Secretariat Review Comments 6 and 7 and to STAP Review Comment 4).

These changes have been achieved by the following amendments:

- **Component 1:** Decreasing resource from 1.48 M USD to 1.4 M USD. This decrease is more than compensated by an extremely high level of co-financing demonstrating strong partner mobilization of resources to support this work.
- **Component 2:** Decreasing resource from 1.79 M USD to 1.68 M USD. Again, a high level of partner co-financing will ensure that the objectives can be met, with the GEF contribution fulfilling a catalytic role.

ANNEX C: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS[7]

A. PROVIDE DETAILED FUNDING AMOUNT OF THE PPG ACTIVITIES FINANCING STATUS IN THE TABLE BELOW:

PPG Grant Approved at PIF: **$150,000**			
Project Preparation Activities Implemented	***GEF/LDCF/SCCF/NPIF Amount ($)***		
	Budgeted Amount	***Amount Spent To date***	***Amount Committed***
Staff & Other Personnel Costs	89,320	89,320	0
Conference services			
Travel	60,680	60,680	0
Total	**$150,000**	**$150,000**	**0**

[7] If at CEO Endorsement, the PPG activities have not been completed and there is a balance of unspent fund, Agencies can continue undertake the activities up to one year of project start. No later than one year from start of project implementation, Agencies should report this table to the GEF Secretariat on the completion of PPG activities and the amount spent for the activities.

ANNEX D: CALENDAR OF EXPECTED REFLOWS (if non-grant instrument is used)

Provide a calendar of expected reflows to the GEF/LDCF/SCCF/NPIF Trust Fund or to your Agency (and/or revolving fund that will be set up)

N/A

UNITED NATIONS ENVIRONMENT PROGRAMME

Programme des Nations Unies pour l'environnement   Programa de las Naciones Unidas para el Medio Ambiente

Программа Организации Объединенных Наций по окружающей среде   برنامج الأمم المتحدة للبيئة

联合国环境规划署

UNEP

Project Document

Section 1: Project Identification

1.1	**Project title:**	Targeted research for improving understanding of the global nitrogen cycle towards the establishment of an International Nitrogen Management System (INMS)
1.2	**Project number:**	5400 PMS:
1.3	**Project type:**	FSP
1.4	**Trust Fund:**	GEF TF
1.5	**Strategic objectives:**	GEF-5 International Waters Strategic Priority 3. (IW-3)
1.6	**UNEP Priority:**	Sub Programme 3, ecosystem management Expected Accomplishment (b) – output 3 the GPA global partnerships on nutrient management
1.7	**Geographic scope:**	Global, multi-country
1.8	**Mode of execution:**	External
1.9	**Project executing organization:**	International Nitrogen Initiative (INI), hosted by CEH
1.10	**Duration of project:**	48 months Commencing: June 2016 Completion: May 2020

1.11 Cost of project

	US$	%
Cost to the GEF Trust Fund	6,000,000	10
Cash Co-financing		
Component 1: Tools for understanding & managing the global N cycle	6,010,172	10
Component 2: Global & regional quantification of N use, flows, impacts & benefits of practices	1,954,440	3
Component 3: Demonstration and verification of full-nitrogen approach at regional/national/local levels (building on existing / planned interventions)	1,857,007	3
Component 4: Awareness raising and knowledge sharing	1,153,382	2
Sub-total	10,975,000	18
In Kind Co-financing		
Component 1: Tools for understanding & managing the global N cycle	18,248,998	29
Component 2: Global & regional quantification of N use, flows, impacts & benefits of practices	14,448,035	23
Component 3: Demonstration and verification of full-nitrogen approach at regional/national/local levels (building on existing / planned interventions)	8,397,624	13
Component 4: Awareness raising and knowledge sharing	4,506,249	7
Sub-total	45,600,907	73
Total	62,575,907	100

1.12 Project summary

The nitrogen challenge

Human perturbation of the global nitrogen cycle in the 21st century is leading both to massive benefits for food and energy production and to multiple environmental threats. Although nitrogen is abundant in the atmosphere in its unreactive form (N_2) it is unavailable for most organisms. At the same time, the supply of reactive nitrogen (N_r) compounds is limited under natural conditions. Anthropogenic inputs of N_r include fertilizer production, crop biological nitrogen fixation, and nitrogen oxides (NO_x) from combustion sources. As a result of these inputs, humans have more than doubled global terrestrial rates of N_r formation.

The benefits have been huge. It has been estimated that fertilizers N_r from the Haber-Bosch process sustain nearly 50% of the human population according to current diets, without which there would be massive problems of hunger and malnutrition in many parts of the world. The increased crop production over the last century has also allowed substantial increases in livestock population, enriching human diets and producing many other products. In addition, agricultural N_r inputs provide a foundation for bioenergy production, offering the potential to replace fossil fuels with renewable products.

Against these benefits, the environmental consequences of anthropogenic fixation of N_2 to N_r have been equally large. The overall global doubling of N_r flows has led to a web of pollution problems, often described in terms of the 'nitrogen cascade', where N_r converts between many chemical forms in different environmental compartments, resulting in multiple environmental impacts. This process is driven by the dissipation of energy contained in the N_r until it is eventually 'denitrified' back to atmospheric N_2. The consequences include water pollution of both freshwater and coastal marine systems, air pollution, greenhouse gas emissions, stratospheric ozone depletion, with threats for ecosystems, biodiversity and soil quality. The result is an array of adverse impacts on environment, health and livelihoods.

The goal of intentional N_r fixation is plant and animal growth, forming many N compounds such as amino acids, proteins, enzymes and DNA. Key losses of N_r include ammonia (NH_3), nitric oxide (NO), nitrates (NO_3) and nitrous oxide (N_2O). Even denitrification losses to form N_2 are polluting, since they represent a waste of the substantial resources (2% of world energy) used to make N_r.

To date, there has been little joined up effort to address these threats and benefits. This is the challenge addressed by 'Towards INMS'. Until now, many GEF interventions have included selected aspects of N as part water quality issues. Similarly, several international projects have addressed the issues of atmospheric NH_3 or N_2O emissions and their possible solutions. Each of these efforts, however, has been conducted in a fragmented way. At the same time, there are substantial barriers to achieve the desired goals of better water quality, cleaner air, reduced greenhouse gas emissions etc.

The INMS hypothesis

'Towards INMS' is developed with the recognition that the present lack of a coherent approach across the nitrogen cycle contributes substantially to these barriers. *'Towards INMS' therefore addresses the hypothesis that joined up management of the nitrogen cycle will offer many co-benefits that strengthen the case for action for cleaner water, cleaner air, reduced greenhouse gas emissions, better soil and biodiversity protection, while at the same time helping to meet food and energy goals.*

This approach also feeds back into each of the usual topic domains. For example, where actions needed to reduce the effects of N on transboundary waters can be shown simultaneously to deliver quantified co-benefits for air, climate, food, energy, then this will more strongly motivate the necessary changes for water protection. The same applies for each of the other threat and benefit policy domains (food, air, climate, soil etc). By acting together through the nitrogen cycle, there is the potential to transform efforts for a cleaner and healthier environment.

Goal of Towards INMS

'Towards INMS' is prepared as a GEF 'Targeted Research Project' at the global scale. This is not research in the traditional sense of focusing on fundamental science. It is rather research in how these issues can be brought together to provide tools, approaches, information and demonstration that can support the mobilization of change at a global scale. 'Towards INMS' is therefore pitched clearly at the interface of science-policy-practice development.

With this framing, Towards INMS, has been developed with a broad partnership to address the following project objective: "*To improve the understanding of the global/region N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems."*[1]

At the same time, it is recognized that 'Towards INMS' has a central role to play in catalyzing the global policy community to develop more effective global and regional strategies to manage the nitrogen cycle. This is the reason that the project is titled "*Towards*" the International Nitrogen Management System. Such an international system of science and practice support for policies in the global nitrogen cycle does not currently exist. 'Towards INMS' is therefore a key step in this process, where the system of science, evidence and options provision (representing the scope of INMS) can work hand in hand with improved coordination among policy makers. 'Towards INMS' thereby parallels ongoing developments in the international policy arena for nitrogen.

'Towards INMS' is highly relevant to support several international policy processes. These include the Global Programme of Action for the protection of the marine environment from land-based activities (GPA), the UN Convention on Biological Diversity (CBD), the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), the UN Framework Convention on Climate Change (UNFCCC), the Vienna Convention (and Montreal Protocol), as well as the regional waters and seas conventions, and the programs of UNEP, FAO, WMO, OECD, UNECE and others. This approach is highly relevant as a focused contribution to meeting many of the Sustainable Development Goals, especially as the nitrogen cycle cuts across so many of the different goals (especially SDGs 1, 2, 3, 6, 7, 8, 9, 11, 12, 13, 14, 15).

Main Anticipated Outcomes

The main outcomes of Towards INMS are as follows:

1. Stakeholders, including policy makers, scientists, industry, farmers, business and civil society, have an agreed basis for informed decision making on N cycle management.
2. Stakeholders using agreed assessment and quantification methods to evaluate N cycle status acting as a common basis for regional/global scenarios to guide management actions.

[1] Discussion with stakeholders during the first Plenary Meeting (Lisbon, 2015) has also framed a *Long-term Goal*: "To improve the understanding of the global and regional N cycle and investigate practices and policies to maximize sustainable production of food, goods and energy while reducing negative impacts of reactive nitrogen on the environment and human health."

3. Regional and Global information on N cycle fluxes and impacts, enabling strategies to be implemented to minimise negative effects of excess or insufficient reactive N, while maximising the quantified co-benefits for other sectors including the Green and Circular Economies.[2]
4. GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised.
5. Local, national and regional expertise to address N_r issues increased and contributes to improved decision-making in the Policy Arena on Nitrogen at the regional / global levels.

Operational outcomes include improved access to and sharing of information in cooperation with IW:LEARN; Improved knowledge management with compiled knowledge and experiences about the project shared with other GEF projects and GEF Secretariat, accessible on IW:LEARN; Improved project execution from IW Conference participation and the use of the GEF5 IW indicator tracking system.

Structure of Towards INMS

The project is structured around four main components:

Component 1

This component will develop the necessary tools and approaches that form the basis for improving understanding and quantification of the global nitrogen cycle, and hence a foundation for developing the necessary interventions at global and regional scales. Component 1 focuses on establishing methods, models and indicators, considering especially the datasets that are required.

The perspective of the work crosses from biophysical dimensions, linking water systems (aquatic and marine) to terrestrial systems (including agricultural and other activities) to atmospheric systems, including emissions, transport, levels of nitrogen compounds and deposition. This biophysical perspective is complemented by the development of economic and social perspectives that are critical in understanding the drivers, opportunities and limitations to achieving better nitrogen management at global and regional scales.

The main elements are:

1) Action to develop better indicators of nitrogen systems, including national and farm scale nitrogen budgeting approaches, a suite of nitrogen use efficiency (NUE) approaches, and the relationship between such budget, balance and efficiency indicators to effect based indicators of societal benefits and adverse environmental effects.
2) Development of a threat assessment methodology, including identification of the key threats, stakeholder review and refinement, development of assessment methods for the different threats.
3) Development of the methodology for combined assessment of nitrogen fluxes and distribution, considering the linkages between air, land and water, and dispersion through trade, including review of methods for different N components and different environmental compartments, leading to the preparation of guidance methodology.
4) Refinement of approaches for threat benefit valuation, including review of existing studies, refinement of methodology across contrasting economies, integration of the benefits and threats for food, health, ecosystem, climate and energy, and the valuation under future nitrogen scenarios.

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[2] Circular Economy: An economy designed to not produce any waste and pollution. Circular economies are characterized by two types of material flows - biological nutrients, designed to reenter the biosphere safely, and technical nutrients, which are designed to circulate at high quality in the production system.

5) Development of flux-impact path models for assessment, scenarios and strategy evaluation, including translating storylines into model requirements, review and comparison of component models, designing model framework, testing and application of selected models in a model cluster.
6) Examination of the barriers to achieving better nitrogen management, linking the economic, social, cultural and other factors that affect adoption of measures, examination of the barriers in food systems and in relation to sustainable consumption, and exploration of the role of a full nitrogen approach and other options to overcome the barriers.

Component 2

The aim of this component is to apply tools, methods and data to synthesize knowledge on nitrogen flows, threats and benefits in the context of the global nitrogen cycle. It will apply key inputs in the form of tools and methods developed in Component 1, together with outcomes from the regional demonstration activities of Component 3, to analyse the current status of N flows, threats and benefits.

Options for improved nitrogen management in different contexts will consider the multiple benefits, linking water, air, greenhouse balance, ecosystems and soils, as well as the interactions with food and energy. These elements will inform the development of storylines and scenarios of different "nitrogen futures" and how these relate to cost-benefit analysis.

The main elements are:

1) Application of a suite of modelling tools to quantify nitrogen flows, threats and benefits at global and regional scales, including developing a shared database of inputs and model outcomes, provision of international support for regional inventory and model development, and integrated analysis to quantify present and future threats and benefits.
2) Preparation of a first global assessment of N fluxes, pathways and impacts, assimilating lessons from the regional demonstrations. The work will draw on the outcomes of Components 1 and 3, while providing material to support the actions of Component 4.
3) Integrating methods, measures and good practices to address issues of excess and insufficient reactive nitrogen, including preparation of a document on the state-of-the-art for good nitrogen management, considering different N forms and N effects.
4) Exploration of future N storylines and scenarios with management /mitigation options and cost-benefit analysis, including review of existing N policies for different countries and regions and review of existing storylines and scenarios.
5) Review of existing interventions and outcomes already achieved by GEF and others.

Component 3

This component establishes targeted research demonstrations on the nitrogen cycle at a regional scale for each of the main world regions. The approach is to demonstrate how a joined up approach to nitrogen management can catalyze stronger action for a cleaner environment (water, air, greenhouse gas, ecosystems, soils) and improved food and energy production simultaneously. The choice of regional scale reflects the need to link between local and global scales, to share regionally specific lessons and to work in partnership with regional intergovernmental and other international processes.

The main elements are:

1) Design common methodology for regional demonstration of nitrogen flows, priorities, mitigation options, co-benefits, success stories, barriers-to-change and ways of overcoming barriers.
2) Conduct the regional demonstrations to refine regional nitrogen assessments and improve understanding of regional N cycle.

3) Use a workshop to synthesize outcomes from demonstration activities focusing on reducing adverse N impacts & maximizing co-benefits.
4) Build consensus on benchmarking N indicators for different regions and systems, linking between the regions and global scale analysis.
5) Refine the regional approach to demonstrate the benefits of joined up N management, leading to concrete plans of how a perspective from the N cycle can be embedded in the future activities of GPA and other national programs and international conventions.

Five regional demonstrations are included with funding support from GEF according to three cases. In addition, at least one demonstration is planned without specific funding from GEF for a fourth case:

1) Developing regions with excess reactive nitrogen: South Asia, East Asia, Latin America
2) Developing Regions with insufficient reactive nitrogen: East Africa
3) Transition economies with excess reactive nitrogen: East Europe.
4) Developed regions with excess reactive nitrogen (West Europe). It is expected that additional input from a North American demonstration may also be developed during the course of the project.

Component 4

The purpose of this component is to support internal and external communication and knowledge exchange in the project. Key to the success of this targeted research activity is the uptake of emerging results by other partners, ongoing engagement and exchange of ideas with stakeholders to ensure that tools and products are fit for purpose and communication of all results in the most effective way.

The work will be informed by the outputs from the other components and the needs and practicalities of partners and external stakeholders.

Information and datasets within the project will be organised and made accessible through the web portal and INMS database system. This foundation will be paired with activities to engage with the N stakeholder community on a variety of levels, including developing a network of 'Nitrogen Champions'. Training will be provided to regional and national experts.

The links between INMS, GPA and other relevant intergovernmental process will be made along with considering the long-term needs for an International Nitrogen Management System. Channels for knowledge exchange with the general public will also be explored and exploited, including refinement of N Footprinting approaches and developing audience relevant communication products.

The main elements are:

1) Establishment of the INMS communications hub and its ongoing operation, including a web portal, the INMS database, internal project communication and press and public engagement functions.
2) Training in nitrogen measurement, modelling and mitigation techniques provided to regional and national experts, international engagement on linking intergovernmental processes and sharing experience on the use of N footprinting to increase public awareness
3) Development of synthesis to demonstrate INMS in support of GPA objectives, co-ordinating the inputs from INMS and into other policy processes and formulating a long-term strategy for INMS, including potential homes and financing options.
4) Harmonization and publication of guidance documents on 'N budgets efficiency and benchmarking', 'threats fluxes and distribution methods', 'N measures and good practices' including information on barriers and successes.
5) Provision of support to IW-LEARN and engagement with GEF & STAP, including connecting the INMS web portal with IW-LEARN, developing a 'Community of Practice', 'Experience Notes' and taking part in IW-LEARN Conferences.

List of Acronyms

Acronym	Full name
ABKAE	Ataturk Horticultural Central Research Institute, Turkey
ADEME	French Agency for Environment and Energy Management
Ag-HU	Research Faculty of Agriculture, Hokkaido University, Japan
AGRA	Alliance for a Green Revolution in Africa
APR	Annual Performance Review
APZIFU	Action Plan for the Zero Increase of Fertilizer Use, China
ARI	Agrophysical Research Institute, Russia
ASU	Institute of Water Resources Engineering, Lithuania
ATB	Leibniz Institute for Agricultural Engineering, Germany
AU	Aarhus University, Denmark
BASF	BASF the Chemical Company, originally: "Badische Anilin und Soda Fabrik"
BFU	Beijing Forestry University, China
BRRI	Bangladesh Rice Research Institute
BSC	Black Sea Commission: Commission on the Protection of the Black Sea Against Pollution
CAA	Clean Air Act, China
CARR	Chinese Academy of Science, Center for Agricultural Resources Research, Institute of Genetic and Developmental Biology
CAS	Chinese Academy of Sciences
CAU	China Agricultural University, Beijing
CBA	cost-benefit analysis
CBD	United Nations Convention on Biological Diversity
CCAC	Climate and Clean Air Coalition
CCST	Centro de Ciência do Sistema Terrestre, Brazil
CCST-INPE	Earth System Science Centre/National Institute For Space Research, Brazil
CDA	Chilika Development Authority, Bhubaneswar, Orissa, India.
CEH	Centre for Ecology & Hydrology, UK Natural Environment Research Council
CEO	Chief Executive Officer
CEMA	European Federation of Agricultural Engineers
CGIAR	Consultative Group on International Agricultural Research
CIC	Intergovernmental Coordinator Committee of the La Plata Basin Countries, Latin America
CIEMAT	Research Center for Energy, Environment and Technology, Madrid, Spain
CIFOR	Centre for International Forestry Research, CGIAR
CIMMYT	International Maize and Wheat Improvement Center, CGIAR
CLRTAP	UNECE Convention on Long-Range Transboundary Air Pollution
CNR	Consiglio Nazionale delle Ricerche, Italy
CNW	China Nitrogen Workgroup
COP	Conference of Parties
CoP	Community of Practice
CPRD	Convention on Co-operation for the Protection and Sustainable Use of the River Danube

Acronym	Full name
COPA-COGECA	European Farmers and Cooperatives Organization, , established from the "Comité des organisations professionnelles agricoles" and the "Comité général de la coopération agricole de l'Union européenne"
CSD	Commission on Sustainable Development
CSF	Committee on World Food Security
CSO	Civil Society Organization
DALY	Disability Adjusted Life Years
DBSB	Danube/Black Sea Basin Strategic Partnership on Nutrient Reduction
DEDJTR	Victorian Department of Economic Development, Jobs, Transport and Resources, Australia
DMG	INMS Demonstration Management Group (for each regional demonstration)
DPBMA	The Prut and Dniester River Basins, Dniester-Prut Basin Management Administration
DRP	The Danube Regional Project
EA	Executing Agency (in the case of Towards INMS, this is the INI as hosted by NERC-CEH)
EAC	East Africa Community
ECLAIRE	Effects of Climate Change on Air Pollution and Response Strategies for European Ecosystems, an EU research project
ECN	Energy Research Centre of the Netherlands
EEF	Enhanced efficiency fertilizers
EMBRAPA	Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária), Brazil
EMEP	European Monitoring and Evaluation Programme, established under the UNECE LRTAP Convention
ENA	European Nitrogen Assessment
ENEA	Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy
EOU	Evaluation and Oversight Unit of UNEP
EPMAN	Expert Panel on Mitigation of Agricultural Nitrogen of the TFRN
EPNB	Expert Panel on Nitrogen Budgets of the TFRN
EPNF	Expert Panel on Nitrogen and Food of the TFRN
EPN-EECCA	Expert Panel on Nitrogen for Eastern Europe, Caucasus and Central Asia Countries of the TFRN
EPOC	Environmental Policy Committee of the OECD
EU-NEP	European Union Nitrogen Expert Panel
EU-TACIS	European Union Technical Assistance for Commonwealth of Independent States
FAO	Food and Agriculture Organization of United Nations
FE	Fertilizers Europe - the European fertilizer industry association
FFCUL	Fundacao da Faculdade de Ciencias da Universidade de Lisboa, Portugal
FSCNB-HU	Field Science Center for Northern Biosphere, Hokkaido University, Japan
Future Earth	Future Earth - an international effort to deliver environmental and related sciences towards global sustainability
GEF	Global Environment Facility
GEFTF	GEF Trust Fund
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environment Protection, hosted by the IMO
GLOC	Global Conference on Land-Ocean Connections
GLP	Global Land Project of Future Earth
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities

Acronym	Full name
GPNM	Global Partnership on Nutrient Management
HBNF	Haber–Bosch N fixation
HELCOM	Helsinki Commission - the Baltic Marine Environment Protection Commission
HTAP	UNECE Hemispheric Task Force on Air Pollution (under the LRTAP Convention)
IA	Implementing Agency (in the case of Towards INMS, this is UNEP)
IAC	Instituto Agronomico de Campinas (Campinas Agronomic Institute), Brazil
IAEM	Institute of agroecology and environmental management of National Academy of Agrarian Sciences, Ukraine
IAI	Inter-American Institute for Global Change Research
IARI	Indian Agricultural Research Institute
ICPDR	International Commission on Protection of the Danube River
ICSU	International Council of Scientific Unions - the International Science Council
IEA	International Energy Agency
IEEP	Institute for Engineering and Environmental Problems in Agricultural Production, Russia
IFA	International Fertilizer Manufacturers Association
IFOAM	International Federation of Organic Agriculture Movements
IGBP	International Biosphere-Geosphere Programme
IGO	Inter-Governmental Organization
IGR-3	Third Intergovernmental Review of the GPA (Manila, January 2012)
IIASA	International Institute for Applied Systems Analysis
IITA	International Institute of Tropical Agriculture, CGIAR
ILRI	International Livestock Research Institute, CGIAR
IMK-IFU	Institute of Meteorology Karlsruhe, Karlsruhe Institute of Technology, Germany
IMO	International Maritime Organization
ING	Indian Nitrogen Group
INI	International Nitrogen Initiative
INMS	International Nitrogen Management System
INPE	Instituto Nacional de Pesquisas Espaciais. National Space Research Agency, Brazil
INRA	National Institute for Agronomic Research, France
IOC	Inter-governmental Oceanographic Commission of UNESCO
IPBPSS	Institute of Physicochemical and Biological Problems in Soil Science, Russia
IPNI	International Plant Nutrition Institute
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Inter-governmental Panel on Climate Change
ISA	Instituto Superior de Agronomia, University of Lisbon, Portugal
ISFM	Integrated soil fertility management
ISSCAS	Institute of Soil Science, Chinese Academy of Science, China
IW	International Waters
IW-LEARN	International Waters Learning Exchange and Resources Network
JNEG	Japan Nitrogen Expert Group
JRC	Joint Research Centre of the European Commission

Acronym	Full name
JSPS	Japan Society for the Promotion of Science
JST	Japan Science and Technology Agency
KIIT	Kalinga Institute of Information Technology, Bhubaneswar, Orissa, India.
KU	Kyoto University, Japan
LA	Latin America
LA UMR	Laboratoire d'Aérologie Observatoire Midi-Pyrénées, France
LBP	La Plata River Basin, Latin America
LOICZ	Land Ocean Interactions in the Coastal Zone, an IGBP project
LRTAP	The Convention on Long-range Transboundary Air Pollution, established under the auspices of the UNECE
LVBC	Lake Victoria Basin Commission
M&E	Monitoring and Evaluation
MakU	Makerere University, Uganda
MAP	Mediterranean Action Plan
MET Norway	Norwegian Meteorological Institute
MOA	Ministry of Agriculture, China
MoE	Ministry of the Environment, Japan
MOE	Ministry of Environment of Moldova
MOEP	Ministry of Environmental Protection, China
MOOC	Massive Online Open training Course
MOST	Ministry of Science and Technology, China
MSFD	Marine Strategy Framework Directive of the European Union
MU	University of Missouri, United States of America
NANC	North American Nitrogen Center of the INI
ND	Nitrates Directive of the European Union
NE	NGO "New Energy"', Ukraine
NEDO	New Energy and Industrial Technology Development Organization, Japan.
NEERI	National Environmental Engineering Research Institute (CSIR), Nagpur, India.
NERC	Natural Environment Research Council, UK
NEWS India-UK	Newton-Bhabha Fund India-UK Virtual Joint Research Centre on Nitrogen Efficiency of Whole-cropping Systems for improved performance and resilience in agriculture
NGO	Non-Governmental Organisation
NIAES	National Institute of Agro-Environmental Sciences of Japan
NIES	Center for Regional Environmental Research National Institute for Environmental Studies, Japan
NinE	Nitrogen in Europe - a networking project of the European Science Foundation which prepared the ENA
N_2O	Nitrous oxide - a greenhouse gas and ozone depleting substance
NH_3	Ammonia - a constituent of biological systems and an air and water pollutant
NH_4	Ammonium - a constituent of biological systems and a water and air pollutant
NO	Nitric oxide - an air pollutant
NO_2	Nitrogen dioxide - an air pollutant

Acronym	Full name
NO_3	Nitrate - a water and air pollutant
NO_x	Nitrogen Oxides (the sum of NO and NO2 concentrations)
NPL	National Physical Laboratory (CSIR), New Delhi, India
N_r	Reactive nitrogen
NUE	Nitrogen Use Efficiency
O_3	Ozone - a reactive gas that forms a protective layer in the stratosphere and pollution in the air we breath.
OECD	Organization for Economic Cooperation and Development
ONU	Odessa National I. I. Mechnikov University, Ukraine
ONW	Our Nutrient World - a report produced for UNEP by GPNM and INI
OSCE	Organization for Security and Co-operation in Europe
OSPAR	Oslo and Paris Commission - the Convention for the Protection of the Marine Environment of the North-East Atlantic
PBI	Planetary Boundaries Initiative
PBL	Netherlands Environmental Assessment Agency
PCH	PigCHAMP Pro Europa S.L., Spain
PCU	Project Coordination Unit, in the case of Towards INMS provided by NERC-CEH
PEMSEA	Partnership in Environmental Management for the Seas of East Asia
PIK	Potsdam Institute for Climate Impact Research, Germany
PIR	Project Implementation Review
PM2.5	Particulate Matter air pollution with a particle diameter of less than 2.5 microns
PMB	Project Management Board of Towards INMS
PPA	INMS Project Partners Assembly (decision making body of INMS)
PPG	Project Preparation Grant
PROBAPS	Project: Protection of the Baltic Sea; benefits, costs and policy instruments
Ramsar convention	Convention on Wetlands of International Importance especially as Waterfowl Habitat
RIVM	National Institute for Public Health and the Environment, The Netherlands
RRes	Rothamsted Research, UK
SACEP	South Asia Co-operative Environment Programme
SAG	Stakeholder Advisory Group of a Demonstration Region within Towards INMS
SANC	South Asian Nitrogen Centre of the INI
SCON	Society for Conservation of Nature, India
SCOPE	Scientific Committee on Problems of the Environment
SDG	Sustainable Development Goal
SDSN	Sustainable Development Solutions Network
SEI	Stockholm Environment Institute
SKWP	SKW Stickstoffwerke Piesteritz GmbH
SMART	Specific, Measurable, Achievable, Relevant and Time-bound indicators and objectives
SPAG	Stakeholder and Policy Advisory Group of Towards INMS
SRI	Scientific Research Institute for Atmospheric Air Protection, St Petersburg
STAP	Scientific and Technical Advisory Panel of the GEF

Acronym	Full name
Statistica.MD	Moldavian Statistics Service, Moldova
TEEB	The Economics of Ecosystems and Biodiversity
TFEIP	UNECE Task Force on Emissions Inventories and Projections (under the LRTAP convention)
TFRN	UNECE Task Force on Reactive Nitrogen (under the LRTAP Convention)
TNO	Nederlandse organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, The Netherlands
Towards INMS	GEF/UNEP project: "Targeted research for improving understanding of the global nitrogen cycle towards the establishment of an International Nitrogen Management System INMS)"
UBA	University of Buenos Aires (Universidad de Buenos Aires), Brazil
UBA	Federal Environment Agency, Germany
UBONN	University of Bonn, Germany
UEA	University of East Anglia, UK
UED	University of Edinburgh, UK
UGENT	Ghent University, Belgium
UKRstat	Ukrainian Statistics Service, Ukraine
UnB	Brasilia University (Universidade de Brasília), Brazil
UNCCD	UN Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEA	United Nations Environment Assembly
UNECE	United Nation Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United National Economic Social and Cultural Organization
UNESP	Sao Paulo State University (Universidade Estadual Paulista), Brazil
UNFCCC	UN Framework Convention on Climate Change
UPCM	University Pierre and Marie Curie, Paris
UPM	Technical University of Madrid
UPMC	University Pierre and Marie Curie, Paris
US-EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USP	University of Sao Paulo (Universidade de São Paulo), Brazil
VNIIOU	Federal State Budget Scientific Institution “All-Russian Scientific Research Institute for Organic Fertilizers and Peat”, Russia
WFD	Water Framework Directive of the European Union
WGSR	Working Group on Strategies and Review of the UNECE LRTAP Convention
WHO	World Health Organisation of the United Nations
WMO	World Meteorological Organisation of the United Nations
WPWBE	Working Party on Water Biodiversity and Ecosystems of the OECD
WRI	World Resources Institute, Washington, USA
WTO	World Trade Organisation
WUR	Wageningen University and Research Centre, The Netherlands
WWF	Worldwide Fund for Nature conservation

Acronym	Full name
ZJU	Zhejiang University, China

Contents

Section 2: Background and Situation Analysis (Baseline course of action)

2.1 Background and context

1. 'Towards INMS' addresses a critical global problem of excess reactive nitrogen in water and the wider environment that has been long recognised by the GEF. This project is designed to better understand the global cycle of reactive nitrogen and represents the first collaborative activity to deliver an International Nitrogen Management System (INMS) that will combine multiple sets of information from different sectors and integrate reactive nitrogen (N_r) across environmental compartments. The project responds to recommendations made by the STAP (*Hypoxia and Nutrient Reduction in the Coastal Zone, 2011)* and reflects the concerns raised at the June 2013 GEF Council by Prof. Rockstom in his presentations on Planetary Boundaries.

2. Recent analysis led by UNEP,[3] highlights the impacts of differing agricultural practices to the releases of N_2O from fertilisers and manures, while WMO[4] has further highlighted the contribution of reactive nitrogen on climate change. Combined with substantial regional and global analyses by UNEP, the LRTAP and others,[5,6,7,8] the findings of these studies emphasize the current interest and importance of the global nitrogen debate.

3. Through this proposed project, the GEF will be in a strong position both to develop a better understanding of the regional and global nitrogen cycles and to assist in developing a management system that would, for example through the GPA, work to combat the negative impacts of reactive nitrogen.

2.2 Global significance

4. The sustainability of our world's population depends fundamentally on nutrients, including reactive nitrogen (N_r) and phosphorus (P). Industrially produced fertilizers (containing N_r and P) are essential to global food security and have been the main driver of dramatically improved agricultural yields over the last 60 years, allowing the human population to grow to over seven billion. At the same time, nutrient loads from continents to oceans and coastal zones (including deposition of N_r from atmosphere) have more than doubled, primarily from agricultural uses (including inefficient application of manure/fertilizer and animal waste), from wastewater (including from rapidly growing cities in both developed and developing world) and from emissions of nitrogen oxides (NO_x) due to fuel combustion.

5. Reactive nitrogen has been highlighted as one of the three 'planetary boundaries'[9] that have been exceeded as a consequence of human activities. The other two exceeded threats are climate change and biodiversity loss from a

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[3] UNEP (2013) *Drawing Down N_2O to Protect Climate and the Ozone Layer.* A UNEP Synthesis Report. (Eds.: J. Alcamo, S.A. Leonard, A.R. Ravishankara and M.A. Sutton). ISBN: 978-92-807-3358-7., United Nations Environment Programme, Nairobi.

[4] WMO press release (6th November 2013). Greenhouse Gas Concentrations in Atmosphere Reach New Record http://www.wmo.int/pages/mediacentre/press_releases/pr_980_en.html

[5] Sutton, M.A. et al. (2011) *The European Nitrogen Assessment: Sources, Effects and Policy Perspectives* (Eds.) Cambridge University Press.

[6] Suddick, E.C. et al. (2012) The role of nitrogen in climate change and the impacts of nitrogen–climate interactions in the United States: foreword to thematic issue. Biogeochemistry, DOI 10.1007/ s10533-012-9795-z

[7] Sutton, M.A. et al. (2013) *Our Nutrient World: The challenge to produce more food and energy with less pollution.* Global Overview of Nutrient Management. CEH Edinburgh, on behalf of GPNM and INI. 114 pp

[8] Austin, A.A. et al. (2013) Latin America's Nitrogen Challenge. *Science* **340**, 149; Eshel, Gidon, et al. Land, irrigation water, greenhouse gas, and reactive nitrogen burdens of meat, eggs, and dairy production in the United States. *Proceedings of the National Academy of Sciences* 111.33 (2014): 11996-12001.

9 Planetary boundaries: exploring the safe operating space for humanity. Rockström, J., W. et. al.. Ecology and Society **14**(2): 32. http://www.ecologyandsociety.org/vol14/iss2/art32/ and Steffen, W. et al. (2015) Science, **347**, DOI: 10.1126/science.1259855

total of nine boundaries overall. The importance of N_r is further raised by links between the carbon and nitrogen cycles and impacts on climate change.[10] This highlights how improved management of the nitrogen cycle must become a core priority for global society in future years. By contrast, the planetary boundary for phosphorus was not initially estimated to be exceeded by Rockström et al., although concerns about global P resource depletion add another dimension to its current pollution impacts at local and regional scales.

6. Estimated global N flows are shown in Figure 1, illustrating how the main sources of new N_r production are fertilizer production (estimated at 120 million tonnes annually, Mt /year), crop biological N fixation (60 Mt / year) and combustion (releasing NO_x at 40 Mt N_r / year). In terms of environmental losses, the recycling flows are equally important. For example, atmospheric nitrogen deposition (NO_x and NH_3) on land amounts to 70 Mt N_r, while 120 Mt is lost from agricultural soils to leaching and denitrification. Around 40-66 Mt of N_r enters the ocean by rivers into the coastal zone, while there is also substantial nitrogen fixation and denitrification in the open ocean. Although in total these ocean fluxes are even larger (at 100 to 250 Mt) they occur over a very large area, with much higher localized N inputs and concentrations occurring in the coastal zone.

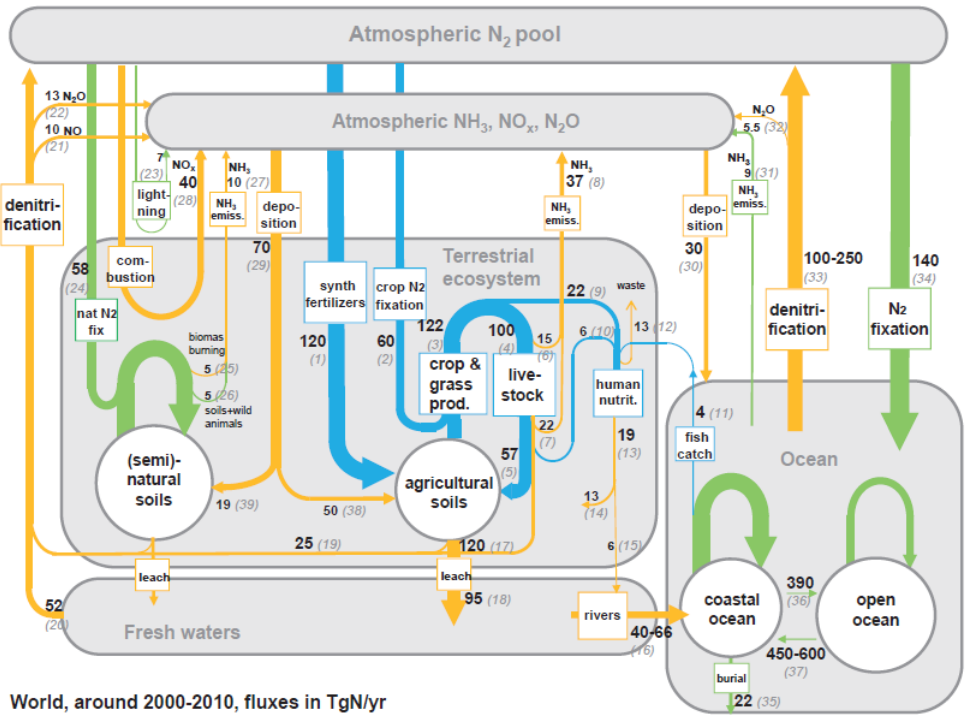

Figure 1: Estimated global nitrogen budget showing intentional agricultural flows (blue), natural flows (green) and untintentional anthropogenic flows (yellow). The numbers in bold indicate nitrogen flows in Tg /yr (= million tonnes or Mt per year) while the numbers in brackets give access to literature sources, as compiled by the 'Our Nutrient World' report (2013).

7. This summary of the main global flows of nitrogen quickly illustrates how the nitrogen cycle is affecting all global compartments linking land, oceans and atmosphere. It also shows the potential magnitude of the benefits arising from better management. The total losses from agriculture amount to a fertilizer value of around 160 billion USD annually. Yet even this is small compared with the estimated societal costs of the associated nitrogen pollution, which were estimated by 'Our Nutrient World' to lie in the range 200 to 2000 billion USD annually. It is obvious that better nitrogen management, especially by emphasizing improved recovery and reuse, has the potential to contribute significantly to both the emerging Green Economy and Circular Economy.

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[10] Gruber, N and Galloway, J. (2008) An Earth-system perspective of the global nitrogen cycle. *Nature* **451**, 293.

8. This proposal leading to the development of the International Nitrogen Management System (INMS) acknowledges the importance in both the benefits and the problems of nitrogen use, and the close linkages between nutrients (specifically nitrogen and phosphorus) in their application in agricultural fertilizers, manures and human wastes, as well as the coupled complexity arising from combustion sources of NO_x emissions to the atmosphere. The prime focus on N_r allows it to address the cross-cutting impacts on pollution, health, climate change, land management, biodiversity, etc., and to identify links with other nutrient cycles for more detailed consideration in the future. These other biogeochemical links include carbon, phosphorus, sulphur, and micronutrients. In developing 'Towards INMS', recognition is given to these interactions and to concerns about both excess N_r impacts and the consequence for regions with typically insufficient N_r. These regional differences are particularly addressed through the 'Towards INMS' demonstration activities.

2.3 Source activities

9. Given the different contributions to new N_r production and the major internal flows in the global nitrogen cycle, particular attention is needed to improve N_r management associated with the following sources:

10. **Fertilizers in agriculture:** In order to feed the world's population approximately 2% of the global energy production is used in the production of N_r, mainly for inclusion in fertilizer. Since the 1960s the use of synthetic nitrogen fertilizer (through the Haber Bosch process) has increased more than nine times. The efficiency in the use of N_r is low with less than 25% incorporated into agricultural products and the remaining 75% being lost to the global environment.

11. **Manures in agriculture:** Most N_r inputs to agriculture go to feed livestock (100 Mt/yr), with only a small fraction used for direct plant food consumption by humans (22 Mt/yr). Waste from livestock is often used ineffectively, contributing to substantial losses from agriculture of N_r to both water and atmosphere. There are a wide range of technologies already available to promote better manure use and to reduce N_r emissions to air and water. One of the main issues is that there is currently a low adoption of these technologies in most developed and developing countries, while implementation of the approaches needs to be tuned to regional characteristics.

12. **Atmospheric emissions and deposition:** In practice, all of the N_r produced in combustion sources is directly emitted as NO_x and N_2O to the environment. In addition, current mitigation technologies are based on denitrification (conversion back to N_2) rather than aiming to recover and reuse the N_r produced. These emissions (40 Mt/yr) are eventually removed from the atmosphere with a fraction being deposited on agricultural land. This is expected to contribute to agricultural productivity, but the gains must be offset against crop losses due to tropospheric ozone (O_3) pollution that results from NO_x emissions, threatening food security. At the same time emissions of ammonia (NH_3) and organic N from fertilizers, manures and biomass burning (47 Mt/yr) combine with NO_x to increase rates of N_r deposition to natural ecosystems, disturbing ecosystem function, both for terrestrial and marine ecosystems.[11,12]

13. **Wastewater (point sources)**: In addition to livestock wastes, human waste contributes significantly to the N_r loads (19 Mt/yr), especially downstream of major cities. In developed (and increasingly in developing countries) wastewater is treated to reduce these sources - often in large energy-demanding centralised wastewater treatment facilities. However, much of the world's population's wastewater remains untreated or inadequately treated. At the same time, where N_r is removed from water, the focus is typically on denitrification approaches, which destroy N_r as a resource rather than recycling it.

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[11] e.g. Dise et al. (2011) in *The European Nitrogen Assessment*, Cambridge University Press.

[12] e.g Kim et al. (2014) Increasing anthropogenic nitrogen in the North Pacific Ocean. *Science* **346**, 1102-1106.

14. According to current trends in increasing population and increasing per capita consumption of animal products, the future will require further use of chemical N fertilizers in several world regions, especially those with currently limited N availability (such as in Africa and large parts of Latin America). In order to avoid increasing losses, much better plant and agronomic approaches will be needed to make better use of the available resource. In agricultural areas with livestock, the significance of the N losses from manure calls at the same time for major improvements in manure N_r recycling, both in terms of amount of manure re-use and the effectiveness of the recycling techniques and technologies.

15. The growth of middle classes is particularly associated with increasing per capita consumption and this is being exacerbated by increasing urbanization exacerbating urban N_r pollution, both to wastewaters and to air. These changes will further increase the threats of N_r pollution, and increase the likelihood of new areas with coastal hypoxia unless more effective nitrogen management practices are developed.

2.4 Threats, root causes and barriers

16. Five key threats of **excess** reactive nitrogen have been identified (see Figure 2) as follows:

- **Water quality:** Excess N_r can lead to the formation of eutrophic conditions in water resulting in hypoxic conditions and the creation of so-called 'dead zones' in coastal waters. In 2011 the GEF STAP highlighted[13] the increasing number of coastal hypoxic zones with a total of over 500 recorded. Coastal hypoxia kills or impairs marine ecosystems leading to reduced fishery production with impacts on human livelihoods and wellbeing. Excess nitrogen pollution of aquifers used as drinking water sources also pose threats to human health.
- **Air quality:** Excess N_r results in shortening of human life through exposure to air pollutants, including particulate matter formed from NO_x and NH_3 emissions, and from increased concentrations of nitrogen dioxide (NO_2) and ground-level ozone (O_3). In addition estimates of N_r inputs to Large Marine Ecosystems (LMEs) indicate that up to 30% can be derived from atmospheric deposition.
- **Greenhouse gas balance:** One of the main effects of N_r on climate is the emission of nitrous oxide (N_2O), which is a greenhouse gas with 298 times higher global warming potential than carbon dioxide. In addition there are several interactions with other N_r forms, carbon, particulate matter and atmospheric N deposition, plus tropospheric O_3 which lead to a complex mix of both warming and cooling effects.[14] Following successful action to reduce emissions of CFC and HFCs, N_2O is now also the main cause of stratospheric ozone depletion, increasing the risk of skin cancer from UV-B radiation.
- **Ecosystems and biodiversity:** In addition to effects on aquatic systems, atmospheric deposition of N_r leads affects many terrestrial ecosystems across the world, posing a significant biodiversity threat. For example it has been estimated that 40% of all biodiversity Protected Areas globally have annual deposition in excess of 10 kg N per ha posting a signficant threat.[15] In particular, many species of high conservation value are naturally maladapted to high levels of N_r, so that many conservation sites are at particular risk.
- **Soil quality:** While N_r is intentionally added to agricultural soils, natural soils are typically adapted to low nitrogen availability. The input of excess N_r into such natural soils can lead to nutrient imbalances, increasing the vulnerability of species, and in particular can result in soil acidification, especially where ammonium (NH_4) inputs are converted to nitrates (NO_3) by microbial oxidation (nitrification) in the soil.

[13] STAP (2011) Hypoxia and Nutrient Reduction in the Coastal Zone: Advice for Prevention, Remediation and Research

[14] Butterbach Bahl et al. (2011) Chapter 19 in *The European Nitrogen Assessment*, Cambridge University Press.

[15] Bleeker A., Hicks W.K., Dentener F., Galloway J. & Erisman J.W. (2011) N deposition as a threat to the World's protected areas under the Convention on Biological Diversity. *Environmental pollution* **159**, 2280-2288.

17. In addition, key threats from **insufficient** reactive nitrogen include:

- **Food security** – Inadequate N_r in agricultural systems is a key limitation to food and feed production. This is especially the case in sub-Saharan Africa, but also in large parts of Latin America and other parts of the world. In particular, lack of N_r inputs does not only reduce yields, but it increase the risk of low yield in unfavorable years. In this way adequate N_r inputs (be it from mineral fertilizer or biological nitrogen fixation) is often considered as form of insurance by the farmer. Better nitrogen management will therefore contribution to improved availability and access to nutritious food.
- **Energy security:** With a need to reduce dependence on fossil fuels, renewable sources of energy are becoming more important. Biomass production is a key such source of renewable energy, for which adequate inputs are necessary just as with other forms of agriculture and forestry. Lack of sufficient N_r therefore limits bioenergy production, with some systems being more demanding than others. The importance of this sector is expected to increase in the future, especially if a larger fraction of agricultural land should be targeted for biomass production for biorefinery into multiple products including energy.
- **Soil quality**: Nitrogen affects soil quality both when in excess (leading to nutrient imbalances and acidification) and when in insufficient supply. In the latter case, a shortage of N_r (and other nutrient inputs) can result in mining soil N_r stocks, depleting them and leading to soil degradation. This can be exacerbated by a shortage of micronutrients and organic matter depletion, leading to loss of fertility and erosion.

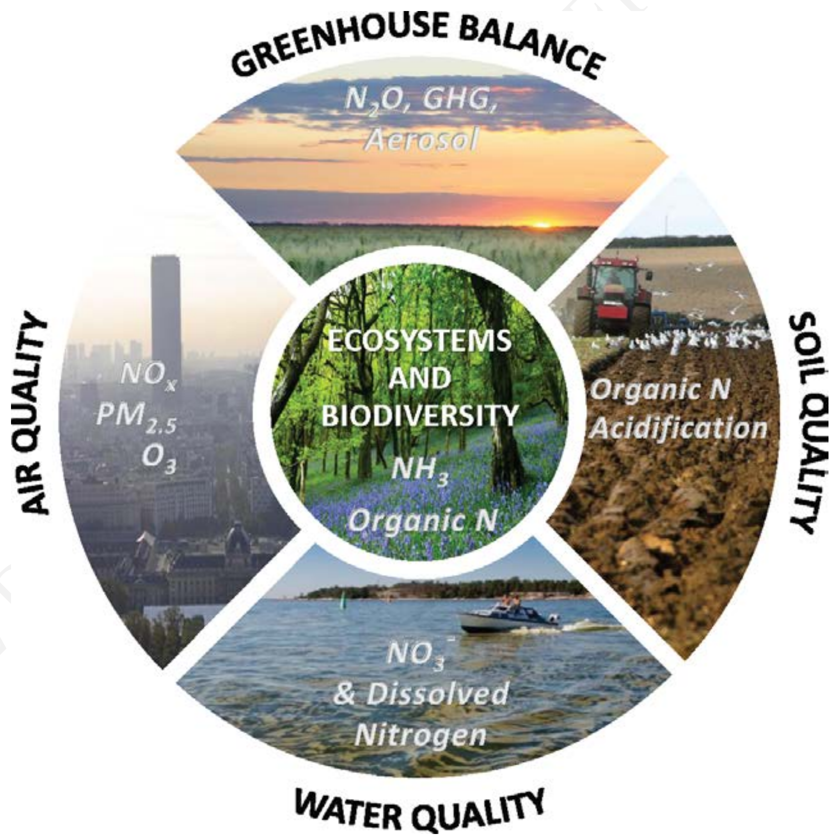

Figure 2: *Five key threats of excess nitrogen in the environment, which can be summarized under the acronym WAGES: Water, Air, Greenhouse balance, Ecosystems and Soils (from Our Nutrient World). In addition, the INMS Pump Priming Workshop (Edinburgh, May 2015) emphasized the importance of nitrogen for both Food and Energy Security.*

18. All of these threats are linked to human disturbance of the nitrogen cycle. In cases with too much N_r, **the root cause** is the search to improve human and livestock nutrition – a goal which has been more than achieved in most

parts of the world. However, the increased N_r inputs have been coupled with a massive increase in N_r losses, due to the **relative inefficiency of agricultural systems**. In addition, as N_r inputs in agriculture increase, the efficiency with which they are used tends to decrease, exacerbating losses. Although significant efficiency gains have been made in recent decades, there are still unsustainably high levels of N_r pollution, with many available technology options not yet adopted.

19. A similar story appears for N_r pollution of water bodies from waste water sources. Although tertiary treatment is available in a few countries, for many there is little basic sewage treatment, with major point sources of N_r (and P) pollution added to rivers, lakes and coastal seas. Even in situations where water is treated for its high N_r levels, the focus is typically on denitrification to remove the N_r, which is a waste of a valuable resource. This threat is being exacerbated by **rapid urbanization**, especially with **inadequate infrastructure**. A key problem is that significant capital expenditure is needed to implement improved water treatment, while existing infrastructure can make it difficult to transform to improved systems where N_r is recovered and re-used.

20. In the case of NO_x, substantial progress has been made through implementations of policies, regulations, and technological advances in reducing, emissions from combustion sources. In particular, adoption of catalytic and non-catalytic abatement technology has reduced emissions converting NO_x to N_2. However, recent technologies especially for vehicles have been showing slower progress in achieving further reductions – as the law of **diminishing returns in refining current technologies** applies. In addition, these gains in lower emission per vehicle mile have been off-set by a rapidly growing vehicle fleet, associated with **increasing transport volumes**. New dimensions are needed to address both these points, including further development of methods for NO_x capture and use (harvesting the value of the N_r produced), as well as to make progress with alternative transport and energy sources with lower NO_x emissions.

21. In considering these root causes and the barriers, to change it is worth to note first that until now each of these issues have largely been considered in isolation. Efforts to promote improved water quality for N_r have not been sufficiently linked to those to improve N_r air quality or reduced N_2O emissions.

22. In this way, increased attention to the nitrogen cycle can contribute in two ways.

a. Firstly, a joined up view promotes the **visibility of the win-win options** and seeks to minimize the adoption of measures with antagonistic effects. For example measures that promote nitrogen use efficiency would be expected to propagate with win-wins through the system, as would measures that promote N_r recovery and reuse in the circular economy. Conversely, measures that reduce N_r pollution by removing it from one place to another may have unwanted side effects. For example, where waste water treatment focuses on denitrification to remove N_r, this may increase emissions of N_2O, in addition to being a waste of the energy used to produce N_r in the first place. This perspective is at the heart of the Towards INMS hypothesis that a joined up approach to N_r management will help overcome the barriers to change.

b. Secondly, a joined up approach to nitrogen management can be expected to have substantial benefits through **improving public awareness**. One of the reasons for lack of progress in better nitrogen management among citizens is a lack of awareness of how the nitrogen cycle links so many well-known impacts. If further progress is to be made then the public need to be better informed promoting a virtuous cycle of interest to find out more and to take action, including recognition of the health and other benefits to citizens. We are already seeing progress in this perspective, as nitrogen begins to be known better to the public. In this regard the narrative connecting nitrogen and food choice has proved particularly successful in raising press interest.[16] An illustration is the option of 'demitarian' (half meat consumption), the consequences of which have been explored at a

[16] As for example, illustrated by the wide global press reception to Our Nutrient World: Smith, B.P. et al. (2013) Communicating 'Our Nutrient World' – a report for UNEP (Published 18 February 2013). March 2013. Centre for Ecology & Hydrology 12 pp. See also Sutton M.A., Howard C.M., Bleeker A. and Datta A. (2013) The global nutrient challenge: From science to public engagement. *Environmental Development* **6**, 80-85.

continental scale,[17] while the word demitarian itself (and the nitrogen narrative with it) has even entered the world of popular gastronomy.[18] These examples illustrate the substantial potential for better public awareness about the nitrogen cycle. If progress is to be made in addressing the barriers-to-change, a sea-change in public awareness will be needed.

23. The role of barriers-to-change also necessitates a global approach. These include the global scale of trade in mineral fertilizers, food crops, animal feed and livestock products, which can constrain the adoption of nutrient best practices. This issue thereby complements the global nature of nitrous oxide pollution emphasizing how action at local, regional and global scales is needed.

2.5 Baseline analysis and gaps

2.5.1 Current Scientific Understanding

24. Scientific efforts over the last decade have substantially increased our understanding on different parts of the nitrogen cycle. Process understanding has advanced significantly, as has scientific knowledge on good management practices. By contrast, there are still major uncertainties in the local, regional and global quantification of nitrogen flows. Similarly, the frequent lack of adoption of available best practices has highlighted the need for integrated scientific-economic-social analyses across the nitrogen cycle to improve understanding of the barriers to change.

25. At the regional scale, work for example in Europe,[19] the US[20] and Latin America[21] has highlighted the level of process-understanding in different biospheric compartments (terrestrial, freshwater, marine, atmosphere, as well as specifically in agricultural systems). In many cases the mechanistic basis for nitrogen transformations is well understood, and the core challenge has been to quantify the relative importance of different N_r sources and sinks. For example, while the magnitude of manufactured N_r inputs is in most cases well known, the regional rates of biological nitrogen fixation and denitrification to N_2 remain uncertain. Similarly, the magnitude of nitrogen oxides (NO_x) emissions from combustion sources to the atmosphere is relatively well known. By contrast, although the scale of ammonia (NH_3) emissions from livestock and crops is reasonably well known, the emissions from biomass burning sources are rather uncertain as are emissions of organic N. In addition, it appears that climate warming will substantially increase NH_3 emissions, but the climate relationships are not included in global models.[22] In terms of freshwater N_r flows, the uncertainty in N_r losses (either as uptake of N_r or N_2 generation) propagates uncertainty in the relationship between catchment N_r export to coastal areas and the net amount of N_r stored in soils and sediments.

26. Considering the multiple impacts of N_r, robust evidence is available on "critical loads" and "critical levels" of N_r for selected temperate ecosystems, which are the thresholds for atmospheric deposition and pollutant air concentrations, respectively, above which significant environmental degradation can be expected. However, major uncertainties remain for different parts of the world and in establishing dose-response relationships (currently being addressed by the EU ÉCLAIRE project). While such critical loads and critical levels are already being applied operationally within the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP), the key challenges

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[17] Westhoek, H. et al. (2015) *Nitrogen on the Table: The influence of food choices on nitrogen emissions and the European environment.* (European Nitrogen Assessment Special Report) Centre for Ecology and Hydrology, UK. 67 pp. See also: Webster, B. (2014) Raise taxes on meat to turn us into demitarians, says UN, *The Times* (25 April 2014), p 17. And the subsequent leader article "Eat Less Meat: A vital message buried in a new report on climate change" *The Times* (15 January 2015), p 30.

[18] Friedland, J. (2015) *Eatymology: The Dictionary of Modern Gastronomy.* Sourcebooks.

[19] Sutton, M.A. et al. (2011) *European Nitrogen Assessment.* Cambridge University Press

[20] EPA-SAB (2011) Reactive Nitrogen in the United States: An Analysis of Inputs, Flows, Consequences, and Management Options - A Report of the Science Advisory Board. (EPA-SAB-11-013).

[21] Austin, A.A. et al. (2013) Latin America's Nitrogen Challenge. *Science* **340**, 149.

[22] Fowler, D. et al. (2013) The Global Nitrogen Cycle in the 21st century. Special Issue of *Philosophical Transactions of the Royal Society*

are to extend application to other world regions and to refine the dose-response relationships in order to connect quantitatively with economic cost-benefit assessments. In the US assessment of nitrogen and climate interactions,[23] the analysis included synthesis on the relationships for both water and air N_r pollution to human health. Such regional assessments form part of the long-term goal through the International Nitrogen Initiative (INI) to stimulate the development of nitrogen assessments for each major world region. Assessments for Latin America,[24] North America, South Asia, Sub-Saharan Africa and China are being developed, with key issues already highlighted through the Global Overview on Nutrient Management: "*Our Nutrient World: The challenge to produce more food and energy with less pollution*",[25] prepared jointly by the Global Partnership on Nutrient Management (GPNM) and the INI.

27. In applying this state-of-the-art to priorities for GEF, the focus must be on research and synthesis that allows tools to be developed that can support actions to address the drivers of N_r pressures and to reduce disruption of the global nitrogen cycle. Key tasks will bring together regional and global analysis of drivers, pressures, flows and impacts in a way that allows the regional challenges to be interrelated. At the core, must be the development and application of shared indicators of threat / benefit and of performance indicators, which can be used to measure progress. For example *Our Nutrient World* provided first national estimates of "full-chain nitrogen use efficiency", which represents the percentage of input nitrogen forms that reach the ultimate intended products used by humans. This interest has since been taken up by GPNM and the EU Nitrogen Expert Panel, as well as within OECD and TFRN. Such approaches need further development to account for all sources (fertilizer, biological nitrogen fixation, combustion sources) and the full suite of final human uses (e.g. food consumed, biofuels, manufactured products).

28. Substantial progress has been made over the last two decades in developing so-called *'integrated assessment models'* as tools to support policy evaluation. An example is the GAINS model for air pollution and climate interactions, which links regional atmospheric emission, dispersion and deposition modeling with costed options for pollution mitigation, thereby allowing the development of cost-optimized abatement scenarios. By contrast, global integrated assessment of the nitrogen cycle is still in its infancy, and it must be a major priority to link models of anthropogenic activities, air, land and water with economic analysis into new tools for global integrated assessment of nitrogen. Through the development of such tools, combined with cost-benefit analysis, a suite of products will allow GEF to provide support global and regional international agreements, maximizing the benefits of N_r while reducing the many adverse effects. Examples of other existing component models that have already been discussed through the UK Funded INMS Pump Priming project (complementing the PPG) include IMAGE, TM5, EMEP, Global NEWS, MEDUSA, NEMO, MAGPIE, CLM, ORCHIDEE. Further work is needed to bring these water, air, terrestrial and economic assessment modelling communities more closely together.

29. Continuing to use and release reactive nitrogen into the environment will add to the problem of coastal hypoxic zones with wider detrimental impacts on health and quality of life stemming from excess nitrogen in both air and water. In particular, current trajectories point to a 70% increase in nitrogen consumption over the next 40 years, which will substantially exacerbate the current pollution problems for international waters and the other environmental and security threats unless action is taken.[26] In addition, regions that have insufficient nutrients leading to concerns on food security need to develop and implement appropriate policies and practices to manage N_r effectively prior to the introduction of modern fertilizers to prevent exacerbation of problems from excess N_r - akin to the 'leap-frogging' in energy supply required in much of the developing world to avoid a high C trajectory.

30. This substantial worsening of N_r loss and impacts, according to anticipated business-as-usual results from a combination of both increasing global population and per capita consumption rates (of food and energy). It is

[23] Suddick, E.C. et al. (2013) The role of nitrogen in climate change and the impacts of nitrogen - climate interactions in the United States. Thematic issue of *Biogeochemistry* **114**, 1

[24] Austin, A.A. et al. (2013) Latin America's nitrogen challenge. *Science*, **340**, 149.

[25] Sutton, M.A., et al. 2013. Our Nutrient World: The challenge to produce more food and energy with less pollution.

[26] Sutton and Bleeker (2013) The shape of nitrogen to come. *Nature* **459**, 435.

therefore vital that a sustainable N pathway is mainstreamed into future policy making to take account of the scientific evidence, recognizing the multiple benefits of taking action.

2.5.2 Relevant baseline programmes and initiatives

31. The GEF (and others) have been supporting local, national and regional actions to develop new and identify best practices for nutrient management. The proposed project is supported by a number of key global initiatives, nutrient and nitrogen research activities and GEF projects that provide significant baseline knowledge and experience.

32. **The Global Program of Action for the Protection of the Marine Environment from Land-based activities (GPA**) works with its member states in their efforts to develop and implement national programs of action, including to identify and assess the nature and severity of problems in relation to: food security and poverty alleviation; public health; coastal and marine resources and ecosystem health, including biological diversity; and economic and social benefits and uses, etc. To date 77 countries have developed national programs of actions and are in various stages of their implementation. The Third Inter-governmental Review (IGR-3), identified nutrient management as one of the core priorities for the GPA and decided to engage themselves and step up their “efforts to develop guidance, strategies or policies on the sustainable use of nutrients so as to improve nutrient use efficiency with attendant economic benefits for all stakeholders, including farmers, and to mitigate negative environmental impacts through the development and implementation of national goals and plans over the period 2012-2016, as necessary”. [27] The next intergovernmental review of GPA is planned for later in 2016 or 2017. Advance preparation with countries, supported by the technical and scientific input of INMS, offers a key opportunity to show how improved nitrogen management can strengthen GPA’s approach to meet its goals over the coming five year period.

33. **The International Nitrogen Initiative (INI)** is a scientific partnership that addresses the problems of excess reactive nitrogen in some parts of the world and insufficient reactive nitrogen in others. It is a joint project of the International Geosphere-Biosphere Program (IGBP) (now in transition to ‘Future Earth’) and the Scientific Committee on Problems of the Environment (SCOPE). INI has established the series of International Nitrogen Conferences, raising awareness of the challenges and developing the foundations for scientific integration, as expressed in the Nanjing (2007), Delhi (2010), Edinburgh (2011) and Kampala (2013) declarations on nitrogen management. INI has provided key scientific input to several intergovernmental processes, including on climate change, regional air pollution, water quality and biodiversity. This includes leadership in the UNECE Task Force on Reactive Nitrogen (TFRN), and delivery of the nitrogen indicator under the Aichi Process for the CBD.

34. The INI operates through regional centres which have been developing regional nitrogen assessments, including the recent European Nitrogen Assessment,[28] which fed in to support the recent revision of the Gothenburg Protocol under the UNECE Convention on Long-range Transboundary Air Pollution. Similarly, the US assessment of nitrogen climate interactions,[29] has contributed to the US National Climate Assessment. The basis for regional assessments for Africa, South and East Asia are currently being developed, but currently require a stronger coordinated approach to ensure engagement between countries, which can only be addressed through the INMS objectives. At the same time, this community development over the last decade has prepared the way to mobilize the international community in support of the GEF objectives.

35. In developing the next stage towards future global nitrogen assessment (GNA) the community of the INI has recognized that a key part of the challenge must be to develop the partnerships of international authorization, while noting that there is currently no international policy framework that addresses the cross-cutting nature of the global

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[27] Manila Declaration: GPA IGR-3

[28] Sutton, M.A. et al. (2011) *The European Nitrogen Assessment*, Cambridge University Press

[29] Suddick, E.C. et al. (2013) The role of nitrogen in climate change and the impacts of nitrogen - climate interactions in the United States. Thematic issue of *Biogeochemistry* **114**, 1.

nitrogen cycle (see section 2.5.3 below). As identified in the '*Our Nutrient World*' report, the next priority must therefore be to build the basis for a more durable international scientific support process.

36. **The Global Partnership on Nutrient Management (GPNM)** is a multi-stakeholder partnership comprising of governments, private sector, scientific community, civil society organizations and UN agencies committed to promote effective nutrient management to achieve the twin goals of food security through increased productivity and conservation of natural resources and the environment. UNEP, through the coordination of the GPA, provides the Secretariat of GPNM. It is a response to the nutrient challenge – how to reduce the amount of excess nutrients in the global environment consistent with global development. The GPNM reflects a need for strategic, global advocacy to trigger governments and stakeholders in moving towards lower nitrogen and phosphorous inputs to human activities. It provides a platform for a common agenda, mainstreaming best practices and integrated assessments, so that policy making and investments are effectively 'nutrient proofed'. The GPNM also provides a space where countries and other stakeholders can forge more co-operative work across the variety of international and regional *fora* and agencies dealing with nutrients, including the importance of assessment work.

37. Although the GPA is an intergovernmental body, it should be noted that the resources available to the GPA are currently limited, while the role of the INI and GPNM are primarily partnerships/NGOs, drawing on diverse and often unconnected resources. The proposed development of the more structured *International Nitrogen Management System* INMS) will therefore allow GEF to pull together substantial diverse efforts to deliver the necessary coordinated global scientific input, which is currently missing from GPA and other international policy frameworks and further engagement of the public in the key debates (see further in Section 3).

38. **Task Force on Reactive Nitrogen (TFRN)** is a body established under the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP). Although a regional body (covering Europe, North America, Caucasus and Central Asia), it is relevant to mention it here as a key part of the baseline of the Towards INMS proposal. The TFRN was established in 2007 by the Executive Body of the CLRTAP. It has the twin aims of providing necessary information to support revision of regional air pollution policies for NH_3 and NO_x (e.g. Gothenburg Protocol Revision, signed 2012) and developing the vision and scientific basis to implement an integrated approach to reactive nitrogen management, counting the multiple co-benefits of taking action. The TFRN has thus developed guidance documents on NH_3 abatement[30] and on national nitrogen budget approaches (now adopted by the LRTAP Convention),[31] as well as examining the relationship between nitrogen and climate, nitrogen and food,[32] and most recently (also in contribution to the development of the INMS proposal) the links between nitrogen in the CLRTAP and the UNECE Transboundary Water Convention (Water, Food, Energy, Ecosystems nexus).

39. A key output of TFRN and the CLRTAP relevant for the present baseline is the *European Nitrogen Assessment* (ENA), which was delivered through support from the European Commission (NitroEurope IP) and the European Science Foundation (NinE and COST 729 programs). Among its other findings, a key conclusion was that the environmental impact of N_r emissions in Europe at around 70 billion to 320 billion Euro per year, was of similar magnitude to the direct agricultural benefits of nitrogen use (not including the downstream benefits in the food chain)[33]. In addition, through the ENA, the TFRN has been critical in developing the thinking for counting the multiple

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[30] UNECE (2014) Guidance document on preventing and abating ammonia emissions from agricultural sources. Executive Body for the Convention on Long-range Transboundary Air Pollution. (ECE.EB/AIR/120). See also: UNECE (2015) *United Nations Economic Commission for Europe Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions*. United Nations Economic Commission for Europe, Geneva

[31] UNECE (2013) Guidance document on national nitrogen budgets. Executive Body for the Convention on Long-range Transboundary Air Pollution. (ECE.EB/AIR/119). http://www.unece.org/environmental-policy/conventions/envlrtapwelcome/guidance-documents-and-other-methodological-materials/gothenburg-protocol.html

[32] Westhoek, H. (2015) *Nitrogen on the Table: The influence of food choices on nitrogen emissions and the European environment.* (European Nitrogen Assessment Special Report on Nitrogen and Food.) Centre for Ecology and Hydrology, UK. 67 pp.

[33] Sutton M.A. et al. (2011) *The European Nitrogen Assessment*, Cambridge University Press.

benefits of improved N use. It should be noted how the TFRN has benefited from and fed into the mature science policy support process of the CLRTAP.[34] This adds significantly to the baseline from which the INMS can learn as it feeds in to support GPA and other policy processes. Finally, the TFRN and ENA have played a key role in raising public awareness of the nitrogen challenge, including developing links with business communities, civil society, communication tools (e.g. ENA video on YouTube) and public awareness through press interventions (e.g. working in partnership with the London-based Science-Media Centre). These actions contribute significantly to the baseline.

40. **Organization for Economic Cooperation and Development** (OECD) has been developing an approach for regional nitrogen balances in agricultural soils. This represents a key baseline that, through partnership with the Expert Panel on Nitrogen Budgets (EPNB) of the TFRN, offers a starting position in the construction of full nitrogen budget approaches. In parallel, the OECD has been exploring the concept of 'Economy-wide Nitrogen Use Efficiency'[35] as a high level indicator to complement the nitrogen budgets approaches. Engagement of INMS with the OECD during the 'Towards INMS' PPG phase has led to the nitrogen challenge being presented to the OECD's Environmental Policy Committee (EPOC) and its Working Party on Water Biodiversity and Ecosystems (WPWBE), building the links with member countries to support engagement in INMS, especially through developing country case studies.

41. **Convention on Biological Diversity** (CBD). As noted above, the INI has the lead responsibility within the Biodiversity Indicators Partnership for developing and implementing the nitrogen indicator under the CBD Aichi Process. The work so far provides a simple starting point for engaging with the nitrogen efficiency approaches developed by Our Nutrient World.

42. **Regional water conventions and other international activities.** It is relevant to briefly mention the wide range of other scientific and policy analyses that support the baseline of the present project. These are highly diverse and for brevity we illustrate here only the main links:

- **Regional Water Conventions.** Key partners of the present project have been central to the delivery of actions within the regional water conventions, including the Helsinki Commission (HELCOM), Oslo and Paris Commission (OSPAR), US-Canada International Boundary Waters Treaty and International Joint Commission, MedPol, Black Sea Convention, Cartagena Convention. The involvement of these groups is represented in the project partnership.
- **Intergovernmental Panel on Climate Change** (IPCC) and the **Framework Convention on Climate change** (UNFCCC). In particular, the TFRN has coordinated input relevant to nitrogen to the 5th Assessment Report, which includes several authors from the project partnership.
- **Food and Agriculture Organization** (FAO) of the United Nations, has recently established its Agenda for Action on livestock management practices and its Livestock Environmental Assessment and Performance Partnership (LEAP), which together with its long term expertise on crop and livestock systems, contribute significantly to the project baseline.
- **International Plant Nutrition Institute** (IPNI) and the **Consultative Group on International Agricultural Research** (CGIAR) are international organizations focused on improving agricultural performance. They have a wealth of data relevant to the present project, especially in relation to approaches to improving nitrogen use efficiency, and in low emission fertilizer practices.
- Through these groups a direct link is established with private sector interests, as highlighted by GEF, including the **International Fertilizer Manufacturers Association (IFA)** and its regional bodies such as **Fertilizers Europe,** with engagement through its leadership of the **EU Nitrogen Expert Panel**), as well as other industry and agricultural

[34] Reis S. et al. (2012) From Acid Rain to Climate Change. *Science* **338**, 1154

[35] Bleeker, A. et al. (2013) Economy-wide nitrogen balances and indicators: Concept and methodology. Organisation for Economic Cooperation and Development (OECD) (Working Party on Environmental Information), ENV/EPOC/WPEI(2012)4/REV1. Paris

business groups (e.g. COPA-COGECA the European Farmers Union, and the International Federation of Organic Agricultural Movements, IFOAM, who have contributed to the Towards INMS PPG phase).

- While livestock and crop agriculture together represent a key source and challenge for nutrient management, links with **Civil Society Groups**, such as through the **European Union Air Quality Stakeholder Expert Group** and the **Global Partnership on Waste Water** will allow the links with other source sectors (transport, large combustion plants, waste water treatment etc.) and public engagement to be further developed.
- The approach is highly relevant as a focused contribution to meeting many of the **Sustainable Development Goals**, especially as the nitrogen cycle cuts across so many of the different goals (especially SDGs 1, 2, 3, 6, 7, 8, 9, 11, 12, 13, 14, 15).

43. The partners of the proposed Towards INMS project have been selected bearing in mind both the leading scientific expertise and access to appropriate tools, and to ensure strong links are made in building on this broad base-line activity, including representatives of governments, private and voluntary sectors and international frameworks. Further details on partners activities contributing to the baseline is given in Appendix 12.

2.5.3 Policy baseline and gaps

44. Until now, national and international policies have been specific to different nitrogen sources (industry, transport, agriculture, waste, etc.) or specific issues (e.g. food supply, health, trade, water and air quality, climate change, biodiversity), but have not addressed the links between these issues.

45. Analysis of existing N_r policies indicates that they have been most successful in sectors consisting of few major actors / source stakeholders (e.g. electricity generation companies, car manufacturers, municipal water treatment companies), but have made less progress when engaging many diverse actors (e.g., transport and food choices by citizens, farmer practices). The challenge of diverse actors requires long-term dialogue, education and training, especially utilizing the 'cluster points' in nitrogen and other nutrient pathways, where a few key actors have the opportunity to influence other parts of the chain (e.g. car manufacturers, supermarkets, local leaders, etc).[36]

46. As a result of this diversity of policy challenges relevant for nitrogen, there are several international conventions and programmes for which nitrogen plays a key role. However, there is currently no international treaty that brings together the different benefits and threats of N_r. The lack of such a joined up approach means that the issues become fragmented, with the implication of often lower willingness to take action.[37]

47. In addition to the need for an integrated policy approach to the many threats and benefits of N_r, it also needs to be articulated why the issue is relevant for policy at the global scale. Firstly, some of the N_r threats are global and hemispheric in nature. These include the threats of N_2O on global warming and stratospheric ozone depletion. Although N_2O is included in the Kyoto Protocol, by sitting alongside CO_2 and CH_4 it often fails to get the specific attention needed to address its control. The case for N_2O and stratospheric ozone is even worse as N_2O is not currently addressed in the Montreal Protocol.[38] A core message from the recent UNEP report 'Drawing Down N_2O' was that an approach to control N_2O needs especially to address overall nitrogen cycling to improve nitrogen use efficiency, which instantly makes the link to the other threats and benefits of N_r. This means that while water pollution and air pollution typically operate at both regional transboundary and local scales, the policy response needs to operate at multiple scales, from global to regional to local. A further reason to develop a global approach is the nature of the barriers-to-change. These are often supra-national in scale, being affected by trade in fertilizers and agricultural products, which can constrain the adoption of the best practices to manage N_r especially if additional costs are involved.

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[36] Sutton, M.A. et al. (2013) Our Nutrient World: The challenge to produce more food and energy with less pollution. Chapter 8

[37] Sutton, M.A. et al. (2011) Too much of a good thing. *Nature* **472**, 159-161.

[38] UNEP (2013) *Drawing Down N_2O to Protect Climate and the Ozone Layer.* A UNEP Synthesis Report. (Eds.: J. Alcamo et al.).

48. It is not the role of 'Towards INMS' to fill this policy gap – that is for the countries and other stakeholders to agree on the most suitable ways forward for better nitrogen governance regionally and globally. By contrast, it is clearly within the role of 'Towards INMS' to better understand these limitations and to develop engagement with the policy community. In this way, 'Towards INMS' is needed to articulate and demonstrate how science evidence can support policy makers and practitioners in better meeting their shared goals linked to the nitrogen cycle.

2.6 Stakeholder mapping

49. Given the wide ranging impacts of the nitrogen cycle, addressing the interface of science, policy and practice is relevant for many different stakeholder groups. This is being addressed in several stages as part of the INMS process:

a) Incorporating well-established partnerships with stakeholders, including those who have been involved in the original conception of 'Towards INMS' (pre PIF stage).
b) Developing partnerships with stakeholders during the PPG phase, specifically to widen the scope of the project activity.
c) Forging new partnerships, including those that will continue to be developed during the life of the project. In such cases contacts so far have served to provide initial introductions, which will become stronger as groups are invited to engage in execution of the INMS Activities.

In Table 1 below, we summarize the nature of the different stakeholder groups and show how they are being included in the developing engagement of 'Towards INMS'.

Table 1: *Summary of main stakeholder groups for Towards INMS and how they are being engaged in the project.*

Stakeholder group	Examples	Engagement in project execution
Nitrogen consumers and local managers	All citizen depend on nitrogen for food, energy and transport. The project is relevant both to members of the public and local managers (e.g., farmers, conservation managers, planners)	Local managers will be engaged through the regional demonstrations, including local case studies of Component 3, while communication activities in Component 4 will engage the wider public, building on established foundation with INI including press engagement.
Private sector	The major private sector interests are fertilizer manufacturers and nitrogen users in agriculture (e.g. farmer groups). Businesses involved in nitrogen innovation also have prospect to become more important.	Fertilizer manufacturer companies and business organizations are involved at global and regional scales, including in indicator refinement (Component 1). Farmer organizations are engaged as stakeholders through the regional demonstrations (Component 3). Links with nitrogen innovators (e.g. agricultural engineering, nutrient recovery and reuse, NO_x capture and utilization will be further developed during the project.
Science and academia	As a targeted research project on the global nitrogen cycle the project is prepared under the lead of the International Nitrogen Initiative (INI), including a wide range of academic partners globally.	Partners of the International Nitrogen Initiative (INI) are involved in all components, especially utilizing the INI Regional Centers (East Asia, South Asia, Latin America, Africa, Europe and North America), which provide the basis to implement the Regional Demonstrations of Component 3.
International Governmental Organizations	Given the wide relevance of the nitrogen cycle several key IGOs are included: UNEP, FAO, WMO, OECD, UNECE, CGIAR (including ILRI, IITA), IIASA	IGOs contribute a wide range of roles in the project, bringing underpinning expertise, information on practices, datasets needed for modelling and access to policy communities, including governments.
Policy and decision-making	GPA, CBD, UNEA, UNECE (LRTAP and Water conventions), UNFCCC, Montreal Protocol, Regional Seas Conventions.	Engaged at national, global and regional scales through development of scenarios, policy options and anticipated benefits (Components 2 and 3). Component 4 will serve to develop wider dissemination and networking beyond the project partnership.

2.7 Linkages with other GEF and non-GEF interventions

50. The GEF (together with other donors) has had a long history of supporting projects to address the problems of excess nutrients and their impacts on coastal zones (summarized in the STAP 2011 report)[39] through the implementation of transformative management changes and through practical demonstration projects, for example reducing nutrient loss from farms through Agriculture Pollution Control (APC) activities in the Danube River Basin. In addition, the GEF has invested in targeted research projects over the past ten years ago to understand nutrient and carbon cycling in coastal zones[40] that will be further built upon within 'Towards INMS'. The problems of insufficient N_r have not previously been a focus under GEF IW, but are highly relevant to avoid emerging pollution problems as human populations rapidly expand. In this context, the project will build on the baseline established by key partners, including amongst work of the CGIAR (formerly the Consultative Group on International Agricultural Research), including the International Institute for Tropical Agriculture (IITA) and the International Livestock Research Institute (ILRI), as well as other partners such as the International Plant Nutrition Institute (IPNI). In order to ensure balance, groups with interest in both conventional and organic farming methods included.

51. UNEP is currently completing the GEF project 'Global Foundations for reducing nutrient enrichment and oxygen depletion from land-based pollution in support of the global nutrient cycle' (Global Nutrient Foundations, or **GNC project**) which contributes to the work of the GPNM and is one of the building blocks contributing to the baseline for the proposed project. The core objective of the GNC project has been "to provide the foundations (including partnerships, information, tools and policy mechanisms) for governments and other stakeholders to initiate comprehensive, effective and sustained programmes addressing nutrient over-enrichment and oxygen depletion from land based pollution of coastal waters in Large Marine Ecosystems". Although the focus is therefore not exactly the same as 'Towards INMS' (with GNC focusing on coastal waters only and nutrients rather than nitrogen), it nevertheless provides outcomes that are relevant for 'Towards INMS'.

52. The present achievement of the GEF/UNEP GNC project can be summarized as:

- The development and application of quantitative modelling approaches: to estimate and map present day contributions of different watershed based nutrient sources to coastal nutrient loading and their effects; to indicate when nutrient over-enrichment problem areas are likely to occur; and to estimate the magnitude of expected effects of further nutrient loading on coastal systems under a range of scenarios.
- A systematic analysis of available scientific, technological and policy options for managing nutrient over-enrichment impacts in the coastal zone from key nutrient source sectors such as agriculture, wastewater and aquaculture, and their bringing together an overall Policy Tool Box.
- A basis that can contribute to future modelling to assess the likely impact and overall cost effectiveness of the various policy options etc. brought together in the Tool Box, so that resource managers have a means to determine which investments and decisions they can better make in addressing root causes of coastal over-enrichment through nutrient reduction strategies.
- The application of this approach in the Manila Bay (Philippines) watershed and at Lake Chilika (India) with a view to helping deliver the key tangible outcome of the project – the development of stakeholder owned, cost-effective and policy relevant nutrient reduction strategies (containing relevant stress reduction and environmental quality indicators), which can be mainstreamed into broader planning.

[39] STAP (2011) Hypoxia and Nutrient Reduction in the Coastal Zone: Advice for Prevention, Remediation and Research

[40] UNEP/GEF The Role of the Coastal Ocean in the Disturbed and Undisturbed Nutrient and Carbon Cycles, executed by LOICZ - a sister programme to the INI under the International Geosphere-Biosphere Programme (IGBP)

- A consolidated global partnership on nutrient management to provide a stimulus for the effective development, replication, up-scaling and sharing of these key outcomes.

53. 'Towards INMS' is conceived with many links to on-going programmes and initiatives with an interest in reactive nitrogen and will actively involve these in both the development of the full-sized project and throughout the project's implementation. It will exploit other GEF interests and achievements in nutrients and coastal eutrophication, including through GEF IW projects including the Transboundary Water Assessment Programme (TWAP) with an expectation of exchange of data and methods. Close links will be established between "Towards INMS" and the GEF Nexus project titled: "Integrated Solutions for Energy, Water, Energy and Land". In both projects, IIASA is involved in a central role of supplying modelling tools and providing scenarios. Thus coordination of activities can be performed by way of IIASA contributors. While the GEF Nexus project focusses on water quantities and their implication on energy (also by way of cooling water) and land use (irrigation), "Towards INMS" views into an additional aspect, water pollution and pollution from the N cycle in general. Both projects will benefit from using common underlying scenarios – in fact, addressing future developments according to the scenarios developed under IPCC (RCP- and SSP scenarios) has been proposed, scenarios which have been co-developed by IIASA and other partners in "Towards INMS" (PBL and PIK).

54. The project is closely linked and aligned to the goals of the GPA and will work with the UNEP Regional Seas Programme to co-ordinate activities and recommendations to protect the marine environment. The Executing Agency (INI) will provide significant links to their programmes, assisting with both excess and insufficient reactive nitrogen, and provide close co-operation with the broader initiatives of the IGBP and SCOPE, including with the LOICZ (Land-Ocean Interactions in the Coastal Zones) programme which GEF IW has previously supported, as well as broader linkages with the international 'Future Earth' research community.

55. 'Towards INMS' will be closely linked with the GEF IW:LEARN to share the experiences and knowledge gained and will actively participate at the International Waters Conferences to further encourage enhanced linkages between the science and policy actors to strengthen the approaches to nutrient management and food security. Similarly, the project will provide a contribution focused on nitrogen that complements the developing Water-Food-Energy-Ecosystem Nexus Assessment of the UNECE Transboundary Waters Convention, as well as activities under the Task Force on Reactive Nitrogen (TFRN) of the UNECE Convention on Long-range Transboundary Air Pollution, including its development of Guidance Documents on nitrogen mitigation, nitrogen budgets and integrated approaches.

56. Complementary international research efforts include major programmes supported by the European Union, such as the completed NitroEurope Integrated Project (64 partners, €28M) and ÉCLAIRE (38 partners, €11M), coordinated by the NERC Centre for Ecology and Hydrology through the INI and TFRN coordination team. The present GEF project will provide significant gravity to catalyze future major European Union and other international funding initiatives in support of its objectives.

57. The INI office has already prepared a future research strategy document in support of this process,[41] and is actively engaged in developing the research agenda with the European Commission (DG Research and DG Environment), including contributing to the European Commission 'Horizon Scanning' on the 'Junction of Health, Environment and Bioeconomy' (JHEB),[42] which clearly profiles the nitrogen and nutrient issues. A newly funded EU twinning project NitroPortugal[43] has just been established, while bilateral funding initiatives (e.g. Newton Bhabha fund between UK and India, UK and China, UK and Brazil) are allowing the establishment of complementary research

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[41] *Managing the European Nitrogen Problem*, Sutton et al., prepared by the Task Force on Reactive Nitrogen (Centre for Ecology and Hydrology / Partnership for European Environmental Research)

[42] Stahel, W.R. et al. (2015) *The Junction of Health, Environment and Bioeconomy: Foresight and Implications for European Research & Innovation Policies.* European Commission.

[43] NitroPortugal: https://www.openaire.eu/search/project?projectId=corda__h2020::874f27c29158672bb240554cc0631796

underpinning that will provide material to strengthen the 'Towards INMS' regional demonstrations. These examples show how Towards INMS can therefore multiply the impact of GEF substantially by stimulating such future funding activities. This reflects the strongly catalytic nature of the 'Towards INMS' approach.

2.8 Conclusions on the project baseline

58. The **baseline** for the proposed project is therefore strong. By contrast, existing efforts to-date have largely focused on the regional scale (e.g. regional water and air conventions), as well as on separate environmental compartments and individual nitrogen threats and benefits. Despite the many efforts to reduce pollution undertaken by GEF and others, there is insufficient understanding of the global N cycle and how this interacts at the regional/national levels. In particular, the understanding and the links between encouraging efficient use of N_r to support food production, while minimizing the environmental impacts of excess nitrogen needs to be strengthened, through the development of specific nitrogen cycle tools and management approaches. At the same time, it is recognized that it must be a priority to link more closely efforts to improve nitrogen management between water (freshwater and marine), air, greenhouse gases and stratospheric ozone depletion, ecosystems and soils, and between these multiple threats and the food and energy security benefits.

59. Substantial preparatory activities have already been made over the last 10 years that now bring the global science, policy and practice communities to the stage where they are ready to take the next step towards developing a more joined up approach. The foundation is therefore well set to show how an understanding of global and regional nitrogen cycles can provide the basis to develop an International Nitrogen Management System that will catalyze better informed decision making and better uptake of practices. By linking the benefits of improved N_r management for environment (water, air, climate, biodiversity etc) with food and energy security at a global scale, 'Towards INMS' offers the opportunity to catalyze change toward a more sustainable world, for example, contributing simultaneously to several of the newly agreed Sustainable Development Goals.

Section 3: Intervention Strategy (Alternative to the baseline)

3.1 Project rationale, policy and expected global environmental benefits

3.1.1 Rationale and Hypothesis

60. 'Towards INMS' is developed with the recognition that the existing approach to science and management of the nitrogen cycle is highly fragmented. There are many benefits and threat of reactive nitrogen (food, energy, water and air quality, greenhouse gases, stratospheric ozone, ecosystems and biodiversity and soils). Yet, there are few experts who have the skills to link all of these issues together. Such a fragmented approach is likely miss potential synergies and may even exacerbate trade-offs between issues. The result is that the present approach to managing the nitrogen cycle is unlikely to provide an optimal set of solutions.

61. In part, the fragmentation of science across the nitrogen cycle is the natural result of a deliberate specialization into focused research communities. While this has allowed significant advances in the details of mechanistic understanding, it has also left science communities with little understanding of each other, resulting in weak communication between related issues across the nitrogen cycle. As a consequence, coherent scientific advice to support improved policies and practices across the nitrogen cycle is often in short supply.

62. These divisions have certainly been amplified by the matching separation of policy areas. For example, differences in policy perspective between actors (e.g., separate departments for agriculture, energy, transport, waste water etc) are compounded by separation between target outcomes (water, air, climate, economy etc).

63. 'Towards INMS' is developed with the recognition that the present lack of a coherency across the nitrogen cycle contributes substantially to the **barriers-to-change** towards a more optimized global nitrogen cycle. This means that to maximize the benefits for one policy domain (such as aquatic ecosystems and the coastal zone) requires taking account of the other benefits that possible actions could contribute. Even more than that, because N_r is a valuable resource, actions that simultaneously contribute to improved business efficiency and profits are likely to provide an even stronger motivation to overcome the barriers to change. To achieve this, however, requires that a more joined-up science approach is delivered, with appropriate tools, options and much wider awareness of the issues.

64. Considering this rationale, **'Towards INMS' addresses the hypothesis that joined up management of the nitrogen cycle will offer many co-benefits that strengthen the case for action for cleaner water, cleaner air, reduced greenhouse gas emissions, better soil and biodiversity protection, while at the same time helping to meet food and energy goals.**

65. This leads to a broad approach where the challenges of one issue become linked to the challenges and opportunities of the interacting issues. For example, where actions needed to reduce the effects of N_r on transboundary waters can be shown simultaneously to deliver quantified co-benefits for air, climate, food, energy, then this will more strongly motivate the necessary changes for water protection. The same applies for each of the other threat and benefit policy domains (food, air, climate, soil etc). By acting together through the nitrogen cycle, there is the potential to transform efforts for a cleaner and healthier environment.

3.1.2 Policy challenge and opportunity

66. The different policy drivers and frameworks linked to nitrogen have already been listed under the relevant baseline and stakeholder mapping in Section 2. Each of these frameworks, such as the GPA, CBD, LRTAP, UNFCCC, Vienna Convention and the regional seas conventions and other groups such as OECD, Commission for Sustainable Development (including SDGs), UNEP, GPNM, CCAC etc, face many challenges to making progress in meeting their goals. In the case of nitrogen, it is evident that these different topic domains hardly work together at present, with many policy opportunities not being fully grasped.

67. This policy landscape provides both a key challenge and opportunity for 'Towards INMS'. The question can be asked: if the science is to be more joined up in evidence provision, how can this foster joined-up policy making and improved adoption of the best practices?

68. These issues have been addressed in Chapter 8 of the *Our Nutrient World* report, which specifically called for the development of international consensus to:

a) Establish a global assessment process for nitrogen between air, land, water, climate and biodiversity, considering the main driving forces, the interactions with food and energy security, the costs and benefits and the opportunities for the Green Economy,
b) Develop consensus on the operational indicators, with benchmarking to record progress on improving nitrogen use efficiency and reducing the adverse environmental impacts,
c) Investigate options for improvement of nitrogen use efficiency, demonstrating benefits for health, environment, and the supply of food and energy,
d) Address barriers to change, fostering education, multi-stakeholder discourse and public awareness,
e) Establish internationally agreed targets for improved N_r management at regional and planetary scales,
f) Quantify the multiple benefits of meeting the nitrogen management targets for marine, fresh-water and terrestrial ecosystems, mitigation of greenhouse gases and other climate threats, and improvement of human health,
g) Develop and implement an approach for monitoring time-bound achievement of the nitrogen management targets, and for sharing and diffusing new technologies and practices that would help to achieve the targets.[44]

69. Altogether this represents a high ambition that cannot easily be achieved in a single step. However, 'Towards INMS' outlines a major contribution to meeting this agenda as part of what must be a longer term ambition. Specifically, it is important to examine each of the components of this agenda, for what is suitable for inclusion in 'Towards INMS' and what must be left as subsequent or parallel steps.

70. In relation to this list, 'Towards INMS' is specifically designed to address points a, b, c and d. In addition, it addresses point f and parts of g, especially in relation to innovation and sharing technologies. By contrast, the setting of internationally agreed goals (e) is the task of governments and policy makers, which a process like INMS may be requested to support in future. With the exception of point e, this list can be considered as matching to the **key criteria** for an appropriate science evidence system to support international policy development.

71. In considering such calls, it is important to distinguish between science support for policy and policy processes. Similarly a distinction needs to be made with policy implementation through in better practices on the ground. These can be considered as three parallel tracks which need to work closely together mutually supporting each other's aims:

- ***Track 1: International Policy Development for Nitrogen****:* This is the role of governments in cooperation with all stakeholders. Negotiation of agreements needs to be based on sound scientific evidence, while also requiring appropriate indicators for monitoring success, which should be based on sound science.
- ***Track 2: Scientific Support for Nitrogen Policy Development***: This matches to the role of an eventual International Nitrogen Management System, for which the 'Towards INMS' project has been developed as key step. The role is necessarily under the lead of the science community and needs to be organized in such a way that all relevant stakeholder inputs are included, while developing an effective approach that is responsive to the needs of policy makers. Key elements of Track 2 include providing the evidence of the multiple threats

[44] *Our Nutrient World* also included targets for phosphorus and micronutrients, however this must be considered as a further step in the global capacity building. This question is being addressed in parallel, for example through the Phosphorus Task Team of the GPNM, bringing in additional issues associated with phosphorus and potash mining, resource depletion and a more specific focus on the water environment. While the Towards INMS approach focuses on integration across the nitrogen cycle, it recognizes interactions with other elements cycles such as C (especially in relation to climate), S (in relation to air pollution), P and Si (in relation to water).

and benefits of nitrogen management, the provision of scenarios demonstrating cost-benefit of particular policy choices, including the harmonization and benchmarking of performance indicators, the sharing and dissemination of best practices, and the synthesis of indicator monitoring.

- ***Track 3: Practices improvement for better N management***: This is the role of all stakeholders, but can be particularly motivated by governments and other stakeholders. Through INMS the science community can play a key role in identification of the most suitable options that maximize the nitrogen co-benefits, while profiling the potential of success stories for wider dissemination and adoption. Implementing wide-scale adoption of better practices is especially the role of governments and agencies.

72. It is clear that **'Towards' INMS is focused clearly on Track 2.** In addition 'Towards INMS' can at the same time support motivation for both Track 1 and Track 3. However, these are fundamentally parallel processes that need to operate under the lead of governments (Track 1) and government agencies and others including business and civil society (Track 3).

73. It is worth reflecting that during the PPG phase different stakeholders have encouraged INMS to follow their own views within this landscape of the three tracks. For example, one agency stakeholder appeared to encourage that INMS also deliver Track 1. Conversely, one business stakeholder made it clear that they did not want to see progress in 'global governance' in connection with nitrogen, implying that INMS should avoid contact with Track 1. From another angle again, a stakeholder from a particular government department emphasized that INMS should reduce its focus on Targeted Research and instead more-strongly prioritize the local implementation of improved practices (Track 3). Such differences of view are natural. They illustrate how the definition of these three tracks can help clarify stakeholder needs. They also emphasize how 'Towards INMS' is a process of building global and regional capacity that can stimulate activity under all three tracks, while developing consensus on the exact balance and relative roles.

74. It may be possible to identify a fourth track: ***Public engagement about the nitrogen threats and opportunities***. Without significant public engagement little substantive progress can be expected in the exchange between policy making, scientific support and practice development. The key actors benefiting from N_r use and contributing to N_r pollution would have insufficient information on how to improve, while governments would not be empowered to take action by their citizens. It is therefore also important that 'Towards INMS' also focuses on developing clear public messages and actively engages with industry, business, media and civil society.

3.1.3 Potential policy homes for INMS

75. Apart from the substantive contributions it provides, it is clear that the longer term aim of 'Towards INMS' is to build the capacity to establish an operational International Nitrogen Management System. With 'Towards INMS' being a project running over the next four years, the aim must be to prepare the way to support global nitrogen policy and practice improvement over the next decade and beyond. In regards of Track 1, **a coordinated approach to international nitrogen policy is currently missing. This means that the very development of 'Towards INMS' presses policy makers to reflect on what they would consider the most suitable architecture to address policies on the global nitrogen cycle.**

76. The central question could be framed most simply as: What would be the most suitable policy home to which INMS should eventually report? This is not an easy question for 'Towards INMS' itself to answer, let alone to resolve during the INMS PPG phase. The reason for this is that the question is primarily one for policymakers themselves rather than for the scientists to answer. Nevertheless, it is appropriate for the INMS science and stakeholder community to consider the issues and reflect on possible options to stimulate thinking by national and international policymakers.

77. In a **first stage** of this discussion (going back over a decade), the fragmentation of science and policy of the nitrogen cycle was first recognized. It was this recognition that led to the establishment of the INI as a focal point to bring science evidence more closely together. At the same time, scientists were often heard to suggest that an

international convention on nitrogen issues was needed. It was such calls for example (Saltsjobaden 2007 workshop), that led to the establishment of the UNECE Task Force on Reactive Nitrogen by the Executive Body of the LRTAP Convention (Decision 2007/1). Nevertheless, although the TFRN was given a mandate to address the full nitrogen cycle from a technical perspective, it still sits within a negotiating context of a specific threat (in this case air pollution). The science call for a new 'nitrogen convention' has also appealed to journal editors given its simplicity (e.g. see the strapline associated with the article in *Nature*[45] that launched the European Nitrogen Assessment).

78. If this call for a 'nitrogen convention' is taken as a starting position, it is also interesting to see the response from policy makers. Through the 'corridor discussions' of many inter-governmental meetings, the present INI chair has posed this question to numerous government officials. The response seems to be almost universally: "we already have enough intergovernmental processes; we don't need more. Do your best to work with the existing processes."

79. This comment should also be seen in the context of a multi-decadal international policy cycle. To summarize broadly: The 1980s was the decade of increasing environmental recognition; the 1990s was the decade of setting up inter-governmental processes and starting to make commitments; the 2000s was the decade of realizing how difficult it is to deliver the commitments; and finally, the 2010s is the decade of avoiding new commitments and even trying to back out of existing commitments. While there are of course exceptions, this *zeitgeist* means that the 2010s are not the ideal decade for establishing any new inter-governmental policy process.

80. These discussions have continued at length at the sidelines of numerous meetings, for example with UNEP, GPA, UNEA, CBD, UNECE (TFRN, LRTAP and the Transboundary Water Convention), OECD, European Commission and with representatives of national governments. At the same time, experience has been gained in better understanding how science can support all these processes, including providing the evidence necessary to support agreements on international protocols, declarations and decisions. A number of themes emerge:

a. The more specific and focused the agreement that policy makers see to make, the more specific and robust the science evidence needs to be to support that agreement.

b. A broad combination of evidence is needed, including information on temporal trends in agreed indicators, scenarios, methods to achieve the desired outcomes (technologies, practices etc), costs of taking action, scale of benefits and cost-benefit analysis.

c. Long-term policy processes with sustained intercessional activity provide the foundation for the most robust, specific and ambitious agreements. One of the reasons for this is that with sustained science input, it allows the parties to a proposed agreement access to a robust long-term body of science, to build confidence in the science evidence, and to be able to request tasks be undertaken by the science community to address their concerns. Together with an improved technical underpinning of the possible practices, it gives the countries confidence to know that their agreement is both achievable and that the benefits outweigh the costs.

d. The evidence needed by policy processes varies between rather simple to highly complex approaches. On the one hand a simple analysis can have great power in policy context (e.g. Planetary Boundaries), while conversely, where there objections, there may be calls for more and more detail. This reflects the interface between political negotiation and science evidence, and emphasizes how the science must go beyond technical approaches also to understand the opportunities and the barriers-to-change.

e. Global policy frameworks need to be able to use evidence of varying detail, especially so as to allow data-poor areas of the world to engage fully in the process. This calls for the science community to be able to deliver a range of approaches to satisfy all needs, from those countries and regions where only basic evidence is possible (implying the need for simple indicators etc) to those developed regions where there is the call for more-sophisticated approaches to be implemented.

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[45] Sutton et al. (2011) Too much of a good thing. *Nature* (11 April 2011).

81. This list could easily be extended. It should, however, be sufficient to illustrate the challenge for 'Towards INMS' to engage with countries in developing a more effective interaction between Tracks 1, 2 and 3 to support better management of the global nitrogen cycle.

82. If the first answer to the question 'what should be the policy home for nitrogen?' was the call by scientists for a self-standing international 'nitrogen convention', then the **second stage** was therefore the recommendation by numerous government officials makers to use one of the existing policy frameworks.

83. To respond to this recommendation, it is necessary to comment on each of the main existing international policy frameworks with regard to their suitability to host an international policy approach on the nitrogen cycle. We follow here the order of the 'WAGES' acronym, starting with Water, and then considering the other options. It should be noted that while this is *not* intended as a critical review of these frameworks, it is inevitably necessary to reflect briefly on their most relevant strengths and limitations.

a. **WATER: Global Programme of Action to protect the marine environment from land-based activities.** (GPA) This is the only international programme to address the connection between land-based pollution and the marine environment. Since the Manila Declaration (2012), nutrients are considered as one of the three core challenges (together with waste water and marine litter) of relevance for the GPA. The nitrogen challenge is therefore closely matched to meeting GPA goals. The GPA process is subject to regular Intergovernmental Reviews of the programme which take place every 4 to 5 years. The GPA has a key strength of working with regional marine conventions around the world. Conversely, a weakness for nitrogen is that the focus is specifically on the marine environment. Issues of wider nitrogen management are therefore not automatically a priority, unless it can be demonstrated how joined-up nitrogen management strengthens the opportunity to meet the marine goals of the GPA. This is indeed a fair opportunity, making INMS highly relevant to GPA. The GPA also has the advantage of strong links through UNEP and GPNM communities. There is also a clear need for science evidence provision to GPA, as shown by experience at the 3rd Intergovernmental Review (IGR-3). However, as it stands, GPA lacks any solid intercessional process.[46] This means that it is currently not easy to connect science efforts between the IGR meetings (every 4-5 years) in order to support to advance planning by the countries of their desired outcomes.

b. **AIR: Convention on Long-range Transboundary Air Pollution** (LRTAP). Substantial progress has been made by the LRTAP convention in addressing the nitrogen issue and pioneering thinking connected with the wider nitrogen cycle. It established the Task Force on Reactive Nitrogen (TFRN) in 2007. This has since supported revision of the UNECE Gothenburg Protocol (e.g. options for the Protocol's Annex IX, critical levels, ENA, key guidance documents). The LRTAP convention has a very strong intercessional process, allowing the building up of both long-term science capacity and a strong mutual understanding of needs between the policy making and science communities. In particular, through the Working Group on Strategies and Review, the architecture of the Convention allows a close interaction between policy and science expertise. Apart from its substantive commitments on N_r emissions reductions to the atmosphere, the Gothenburg Protocol took a significant step in introducing voluntary reporting of national nitrogen budgets, following the methodology prepared by the TFRN. The limitations of the LRTAP convention for an integrated approach on the global nitrogen cycle are two-fold: Firstly, the convention is limited to goals related to air pollution, and secondly, it only covers the geographic scope of the UNECE region. Although the UNECE Transboundary Waters Convention has shown that it is possible to include Convention parties beyond this region, it has so far not proved possible to agree this within LRTAP. There is also the potential for much stronger cooperation between the UNECE LRTAP and Transboundary Waters conventions. However, these have different modes of operation, which provides a barrier to stronger linkage.

[46] In principle, this might be provided through the Global conference on Land Ocean Connections (GLOC), as first held simultaneously with IGR-3 at Manila in 2012, with GLOC-2 held in Jamaica in 2014. However, the connection as an intercessional preparation for anticipated governmental agreements (e.g. with IGR-4, in 2016 or 2017) has not yet been made.

c. **GREENHOUSE GAS: Intergovernmental Panel on Climate Change** (IPCC) and the **UN Framework Convention on Climate Change** (UNFCCC). At present the UNFCCC must be one of the largest and most ambitious international agreements linked to the environment, having grown substantially since its establishment in the 1990s. The IPCC is also one of the world's leading science assessment processes. These are key strengths of UNFCCC as a potential policy home for nitrogen, which could for example emphasize the links between nitrogen and climate change, as discussed in both the European and North American nitrogen assessment processes. Against this opportunity is the complexity of dealing with an extremely large organization that is already over-busy with its own challenges. As it stands, nitrous oxide gets limited attention within the wider basket of Kyoto gases, while the chances, in practice, of embedding a 'full nitrogen approach' at the present time within UNFCCC appear to be negligible . The UNFCCC appears already to face more than enough challenges, as illustrated by the respectful decline of its secretariat to take part in the 'Towards INMS' First Plenary Meeting (Lisbon, 2015). It can also be questioned whether the UNFCCC - IPCC model offers the most suitable approach for a nitrogen policy home given the very strong separation between the science evidence (IPCC) and the negotiation process (UNFCCC). As shown by the contrasting close linkage between policy makers and scientists in the LRTAP - TFRN approach, there are substantial benefits to be found from developing a close interface between these groups.

d. **ECOSYSTEMS AND BIODIVERSITY:** UN Convention on Biological Diversity (CBD). The INI already works closely with the CBD acting as the delivery partner for its nitrogen deposition indicator under the Aichi Targets process . This has led to INI contributing to several CBD meetings, building understanding of the CBD process. At the same time, the CBD secretariat has been similarly active in supporting the development of 'Towards INMS'. CBD represents a highly diverse set of biodiversity interests and in this sense could be well placed to develop as an international policy home for nitrogen. On the other hand, this very same diversity and complexity can be equally considered as a barrier, as it become hard in the busy 'CBD market-place' to profile an issue like nitrogen, which is under strong internal competition for attention with many other topics. As the challenge of nitrogen is fundamentally biogeochemical, while N_r is multi-source, multi-impact (matching to CBD), it nevertheless has a closer commonalty with other conventions dealing specifically with material flows (like GPA, LRTAP, UNFCCC).

e. **SOILS**: While the WAGES model considers soil quality as the fifth main threat of too much or too little nitrogen, there is not currently any specific intergovernmental process focusing on this threat. The closest connections could be seen with the objectives of the UN Food and Agriculture Organization (FAO) and with the developing process under the high level Sustainable Development Goals. While in many cases relevant for nitrogen, it is currently hard to see that these processes could be the primary policy home for nitrogen, as they either mainly focus on only one part of the story (FAO, improved food supply) or take a very generic high-level approach (SDGs) for which delivery partner organizations will anyway be necessary to make substantive progress.

f. **STRATOSPHERIC OZONE**: Vienna Convention and Montreal Protocol. In addition to the original five threats of the WAGES model, it is recognized that N_2O now represents the main source of stratospheric ozone depletion. Given this point, it has been discussed whether N_2O control should become part of the group of pollutants that are addressed under the Montreal Protocol (as it is currently not included).[47] Advocates of its inclusion emphasize the success of the Montreal Protocol in decreasing CFC and HFC emission substantially over the last 20 years. Conversely, critics have emphasized that the success of the Montreal Protocol was connected with the availability of finance to support transition, while being focused on a few large well-organized companies producing CFCs and HFCs. Although some N_2O arises from large industrial operations, over 70% arises from agricultural sources, implying the need for the Montreal Protocol to deal with a much wider and more diverse set of stakeholders than it has in the past. Irrespective of this debate, it remains an open question whether the Montreal Protocol would be ready to make a double leap to next address all the main polluting and beneficial effects of reactive nitrogen.

[47] UNEP (2013) Drawing down N_2O report.

84. In addition to these issue-based international approaches, it is also worth mentioning the importance of other frameworks:

a. **Organisation for Economic Cooperation and Development** (OECD). This represents most of the developed countries in the world providing support and analysis for international policy and economic development. It also has experience of nitrogen and as a partner of 'Towards INMS' is engaged in mobilizing better understanding of the nitrogen cycle for policy application. In this regard, OECD acts as a global think-tank, disseminating innovative ideas, analysis and indicators to support the economies of its member countries. OECD also provides standards and benchmarks, for example in the field of chemicals and the environment. OECD does not, however, represent any policy process with specific policy goals. In that sense, while the cooperation between 'Towards INMS' and OECD offers substantial opportunities in refining ideas and mobilizing interest across governments, a different kind of organization/framework is needed as the prime policy home for an international approach on nitrogen.

b. **Global Partnership on Nutrient Management** (GPNM) The relevance and close connection of GPNM with INMS has already been outlined, for example, with INI leading the delivery of the Global Overview on Nutrient Management 'Our Nutrient World' in cooperation with UNEP and GPNM. The GPNM itself consists of a multi-stakeholder partnership between interested countries, industry, agronomy, environmental management and academia. The GPNM was important in bringing together support to the 3rd Intergovernmental Review (IGR-3) of the GPA in Manila. While GPNM can fulfil a catalytic function as a professional network building connections between the partners, it is clear that this is a different goal to that of an international nitrogen policy home.

c. **Climate and Clean Air Coalition** (CCAC). This is a voluntary group where countries and other stakeholders commit to take part with the common aim to reduce short lived climate polluters, especially methane and black carbon. Having identified a set of measures for reducing emissions, the CCAC promotes funding for actions to reduce these emissions as a contribution to meeting both climate and air pollution goals. As part of its agriculture programme, there is an important connection with nitrogen through manure management. Cooperation between CCAC and Towards INMS is therefore important and is facilitated especially within 'Towards INMS' by the Stockholm Environment Institute (University of York). Nevertheless, it is clear from the focus of CCAC that it is not designed to act as the main policy home for a multi-impact approach to manage the global nitrogen cycle.

85. Several of these frameworks are therefore highly relevant for nitrogen. Nevertheless, the message of this short review is that none of the existing bodies (as they stand at present) is optimized to act as a single main policy homes for nitrogen. This, is of course, not surprising. If the solution were easy, it would have already presented itself at an earlier stage.

86. The comparison of these different frameworks does, however, prepare the way for a **third stage** in the developing narrative. This originated during discussions in the margin of the United Nations Environment Assembly (UNEA-1, 2014) and subsequent discussions at the Environmental Policy Committee (EPOC) of the OECD (February 2015). Here the approach is intermediate between the first model (a 'nitrogen convention') and the second model ('work with existing conventions'). Under this approach, the importance is recognized of the '**policy arena for nitrogen**', which links each of the main environmental and other international frameworks. Such a policy arena is not primarily conceived as a convention in its own right, but rather a framework that makes the links to ensure better informed policy coordination between the existing international conventions and programmes.

87. As can be seen from the diagram below (Figure 3), the nitrogen policy arena is seen as being served with scientific support from the International Nitrogen Management System, while providing the connections with each of the other international frameworks. In this way, establishing a focused nitrogen policy arena can be seen as a much more achievable goal. It both 'works with existing' and addresses the present lack of policy coordination.

88. As regards a possible home for such a nitrogen policy arena, this must be a question for further discussion by countries. Both UNEA and OECD can serve as important forums in the first instance to further refine the concept and build support with countries for the approach. At a regional scale, frameworks such as UNECE, the South Asian

Cooperative Environment Programme (SACEP), Partnership in Environmental Management for the Seas of East Asia (PEMSEA) and other regional bodies could serve to support and further develop the approach in cooperation with the global nitrogen policy area. The exact form and design of the Policy Arena for Nitrogen must be a matter of further development. Although this concept has developed during the PPG phase of 'Towards INMS', it is a discussion that must continue with countries during the life of the project.

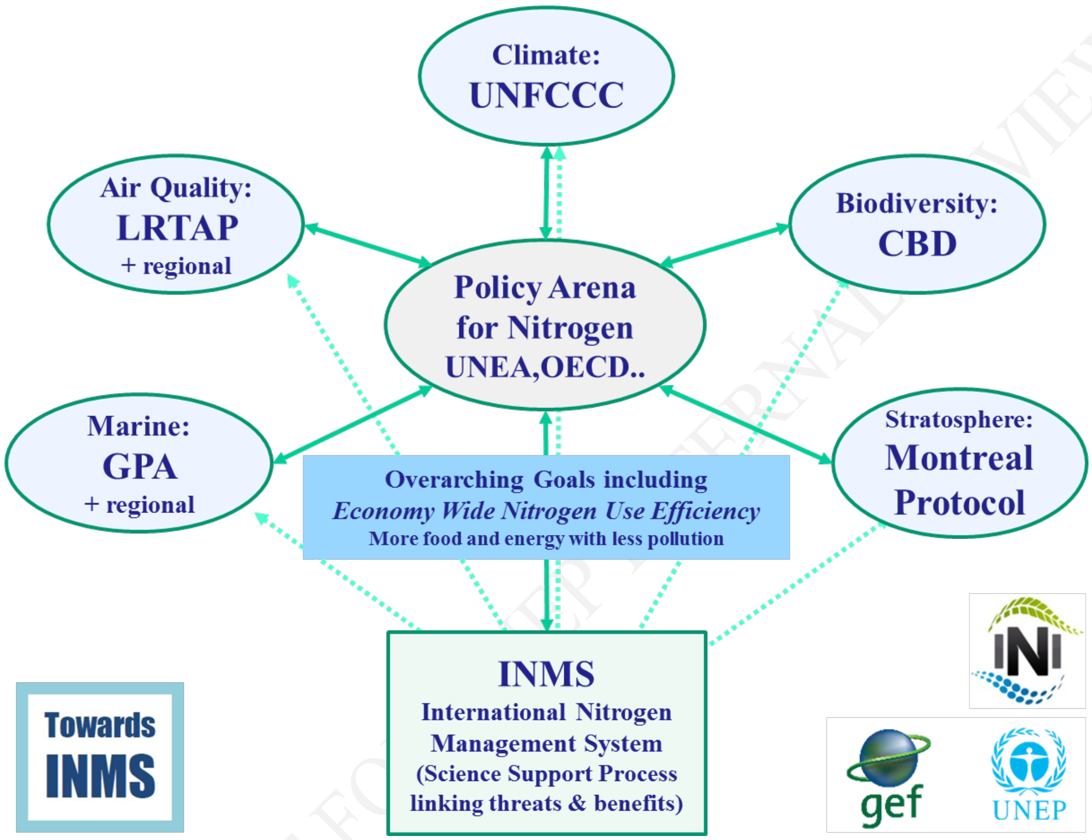

__Figure 3:__ Initial concept of the Policy Arena for Nitrogen showing how it may connect science support from INMS with the major effect based international agreements. Currently, these international agreements largely operate in isolation from each other failing to exploit the many synergies that operate across the global nitrogen cycle. In this approach, the policy arena provides a mechanism where governments can link their policies and strategies promoting a more optimized approach, while drawing on the scientific and technical support from INMS. Arrows also operate directly between INMS and the specific policy frameworks focusing especially on promoting improved understanding of the relevant needs as well as continuing to provide direct technical support where necessary.

89. In summary, at present, it is envisaged that 'Towards INMS' would engage with policy frameworks at three complementary scales:

a) Continuing and strengthening science support to individual multilateral agreements, according to their specific topic focus (e.g. GPA, CBD, UNECE/LRTAP, UNFCCC, Vienna Convention, FAO, WHO etc),
b) Continuing to work with relevant global and regional multi-stakeholder partnerships to build deeper understanding of the cross-cutting issues (e.g. GPNM, CCAC),
c) Initiating new developments to work with countries towards Policy Arena for Nitrogen, continuing to engage in this process with overarching frameworks that could take an eventual lead (e.g. UNEA, OECD).

90. With the concept of the Policy Arena for Nitrogen having been developed at UNEA-1 (June 2014) and in interaction with OECD EPOC (February 2015), it was subsequently presented for discussion to the First 'Towards INMS' Plenary Meeting (Lisbon, April 2015). This allowed an open discussion of the concept chaired by UNEP garnering wide stakeholder feedback. Overall, there was support for the concept, with no objections to the general description of relationships, while agreeing on the need for both INMS and the Nitrogen Policy Arena at the heart of the diagram. The overall message of the stakeholders was one of high ambition to strengthen and extend the concept by increasing the number of linkages and goals. If the outcome of this consultation (see Figure 4) seems rather daunting, it clearly highlights the common message of the importance of nitrogen to all these domains.

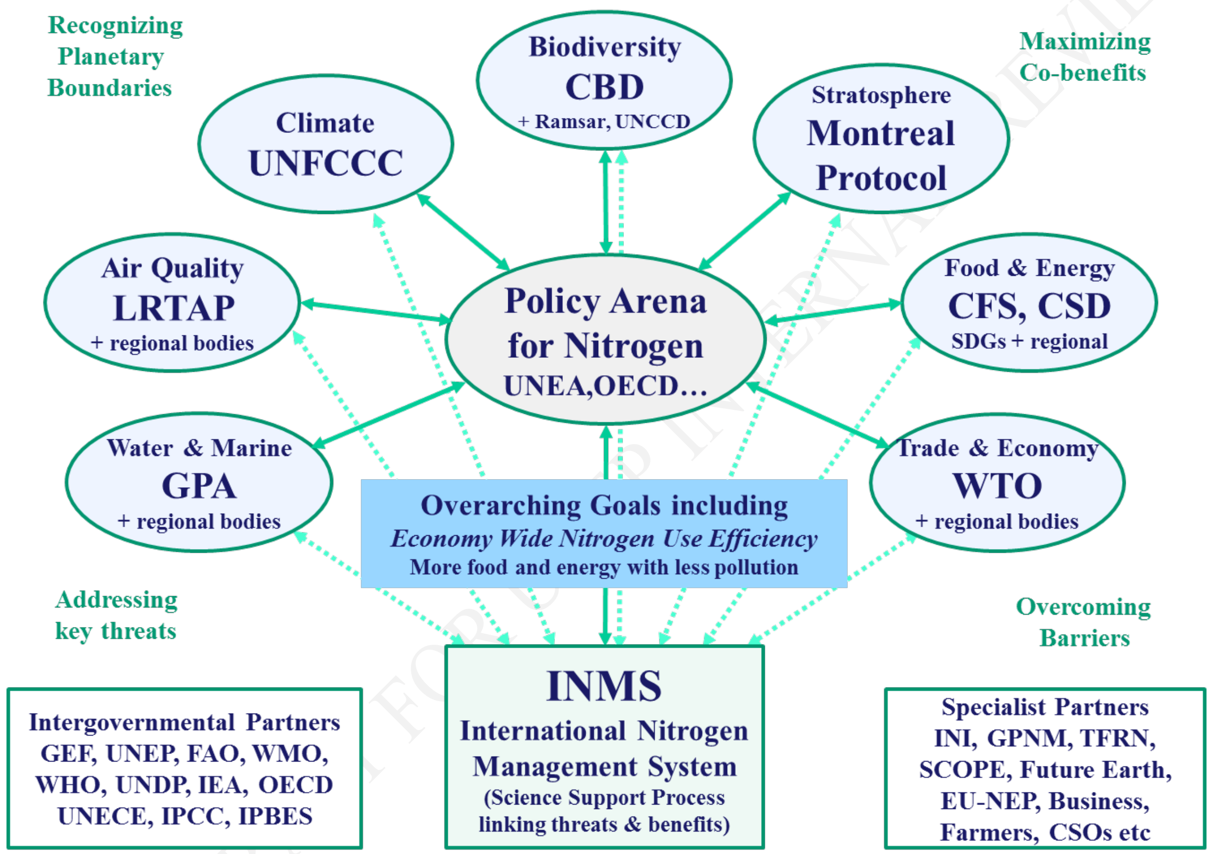

Figure 4: *Revised and extended concept of the Policy Arena for Nitrogen (Figure 3) following feedback from stakeholders during the First 'Towards INMS' plenary meeting (Lisbon, April 2015). The stakeholders indicated a high ambition to increase the number of connections, recognizing the multiple ways in which nitrogen has both benefits and threats, the needs to address barriers-to-change and the rich landscape of relevant intergovernmental and specialist partners. It remains an open question which version is most effective for public communication.*

Additional acronyms: *UNCCD is the United Nations Convention to Combat Desertification; CFS is the Committee on World Food Security; CSD is the Commission on Sustainable Development, under which Sustainable Development Goals (SDGs) are being developed; WTO is the world trade organization. WMO is the World Meteorolgical Organisation; WHO is the World Health Organisation; IPBES is the Intergovernmental Platform on Biodiversity and Ecosystem Services; IEA is the International Energy Agency, EU-NEP is the EU Nitrogen Expert Panel; SCOPE is the Scientific Committee on Problems of the Environment; CSOs is civil society organizations.*

91. The high ambition of Figure 4 may even go beyond what is realistically feasible to achieve in 'Towards INMS' in the next four years. However, it clearly indicates a strong mandate from stakeholders to continue with the process,

building the connections towards a joined-up nitrogen approach between countries, business, civil society and the global scientific community.

3.2 Objective and long-term goals of 'Towards INMS'

92. 'Towards INMS' is prepared as a GEF 'Targeted Research Project' at the global scale. This is not research in the traditional sense of focusing on fundamental science. It is rather research in how these issues can be brought together to provide tools, approaches, information and demonstration that can support the mobilization of change at a global scale. 'Towards INMS' is therefore pitched clearly at the interface of science-policy-practice development.

93. **PROJECT OBJECTIVE** With this framing, 'Towards INMS' has been developed with a broad partnership to address the following objective:

94. "To improve the understanding of the global/region N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems."

95. The project objective remains unchanged from the PIF. At the same time, extensive discussion with a wide range of stakeholders during the First Plenary Meeting of 'Towards INMS' (Lisbon, April 2015), has allowed this to be complemented by the definition of a **First Long-term Goal:** ***"To improve the understanding of the global and regional N cycle and investigate practices and policies to maximize sustainable production of food, goods and energy while reducing negative impacts of reactive nitrogen on the environment and human health."*** In comparing these statements, it is clear that the stakeholder agreement on long-term goal extends the Project Objective to consider also the relevance of nitrogen impacts for human health, as well as to consider the benefits of improved nitrogen use for food, goods and energy. Although the long-term goal does not explicitly mention the different scales (global/regional/local) these points were taken by the stakeholders as being implicit, while they remain explicitly addressed within the 'Towards INMS' objective and work plan.

96. It is recognized that 'Towards INMS' has a central role to play in catalyzing the global policy community to develop more effective global and regional strategies to manage the nitrogen cycle. This is the reason that the project is titled "*Towards*" the International Nitrogen Management System. Such an international system of science and practice support for policies in the global nitrogen cycle does not currently exist. 'Towards INMS' is therefore a key step in this process, where the system of science, evidence and options provision (representing the scope of INMS) can work hand in hand with improved coordination among policy makers. 'Towards INMS' thereby parallels ongoing developments in the international policy arena for nitrogen.

97. Recognizing this parallel challenge, a **Second Long-Term Goal** of 'Towards INMS' can be distilled as:

"To develop the global community of experts in the benefits and impacts of nitrogen, in cooperation with a broad partnership of key stakeholder interests, into an effective system of evidence provision that can support improved strategy and policy development at global, regional and local scales."

The focus of this goal is therefore on building the capacity and organizational system as a foundation to deliver the substantive outcomes and outputs of the process.

3.3 Outcomes, Outputs and Key Aims

98. In following the GEF approach, 'Towards INMS' is structured with several planned overarching **Outcomes** and **Outputs**. These cover the full breadth of the project including process-related results. In addition, we summarize below seven 'Key Aims' which draw attention to some of the most important elements.

3.3.1 Project Outcomes

99. The planned Outcomes of 'Towards INMS' are as follows, numbered according to the their link to Components 1 to 4, as already agreed in the Project Initiation Form (PIF):

1.1. Stakeholders, including policy makers, scientists, industry, farmers, business and civil society, have an agreed basis for informed decision making on N cycle management.
1.2. Stakeholders using agreed assessment and quantification methods to evaluate N cycle status acting as a common basis for regional / global scenarios to guide management actions.
2. Regional and Global information on N cycle fluxes and impacts, enabling strategies to be implemented to minimise negative effects of excess or insufficient reactive N, while maximising the quantified co-benefits for other sectors including the Green Economy.
3. GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised.
4.1 Local, national and regional expertise to address N_r issues increased and contributes to improved decision-making in the Policy Arena on Nitrogen at the regional / global levels.
4.2 Improved access to and sharing of information in cooperation with IW:LEARN.
4.3 Improved knowledge management with compiled knowledge and experiences about the project shared with other GEF projects and GEF Sec. and accessible on IW:LEARN.
4.4 Improved project execution from IW Conference participation and the use of the GEF5 IW indicator tracking system.

100. Although these Outcomes are each linked primarily to one of the four project Components, it is clear that there is substantial synergy between the Components in delivering them.

101. The design of the INMS project has been supported and informed by the analysis of the problems resulting from too much and too little nitrogen. A simple assessment based on the theory of change has supported the overall design of the projects' outputs and activities (to meet the expected outcomes). A basic 'problem tree' and theory of change relationship is presented in Appendix 19. The problem tree will be used throughout the project to guide actions and will be modified if required. It is expected that the theory of change will be reassessed, and if required reformulated, by the mid-term and terminal evaluations.

3.3.2 Project Outputs

102. The main Outputs of 'Towards INMS' are as follows, as already agreed in the Project Initiation Form (PIF):

Component 1:

1.1. Development of Indicators for assessing full N budgets, use, levels and impacts, including N use efficiency and benchmarking. Indicators would be developed of relevance for specific stakeholders (e.g. private sector - fertilizer producers).
1.2. Methodology for threat assessment.
1.3. Development of tools for valuation of the threats and benefits of N that are of use to multiple stakeholders groups (including the private sector).
1.4. Methods for determining N fluxes and distribution of N (water, air, land, agriculture, industry, etc.).
1.5. Approach to using existing N flux/pathway models for regional assessments and visualisation for potential scenarios to assist with development and reduction strategies.
1.6. Understanding the barriers to change at all levels of society (government, private sector and civil society) including technical, financial and socio-political limitations.

Component 2:

2.1. Quantification and assessment of the regional threats from excess N and insufficient N.
2.2. Detailed overview of regional/local N flux and consolidation into a global assessment of N fluxes and pathways
2.3. Consolidation of methods and good practices to address issues of excess and insufficient N_r.
2.4. Definition of programmes and policy options for improved N_r management at local/regional/global levels, supported by cost-benefit analysis to underpin options for the Green Economy.
2.5. Compendium summarizing the state of knowledge, experience and measures adopted by GEF (and others) gained from addressing the issues of excess and insufficient N_r.

Component 3:

3.1. 3/4 regional/national/local demonstration activities (that build on existing or planned nitrogen management actions providing catalytic results) deliver conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing:

Case 1: Challenges and opportunities for developing areas with excess reactive nitrogen;

Case 2: Challenges and opportunities for developing areas with insufficient reactive nitrogen;

Case 3: Reactive nitrogen challenges and opportunities for regions with transition economies;

Case 4: Challenges and opportunities for developed areas with excess reactive nitrogen (using co-financed resources only).

3.2. Assessment and quantification of impacts from piloting activities to reducing negative impacts from poor N_r management, while demonstrating the co-benefits for other issues.
3.3. Refined benchmarking of indicators for different regions and nutrient flow systems.
3.4. Plans for inclusion of agreed approach to N cycle assessments agreed in support of the emerging Policy Arena on Nitrogen in engagement with GPA, OECD, UNEA and other bodies.

Component 4:

4.1 Information sharing and networking portal (with links to GPA) to assist the GPA, OECD, UNEA, UNECE and other bodies with uptake of understanding of N_r cycle and means to mitigate negative impacts.
4.2 Training for regional/national experts to sustain and enhance understanding of global N cycle implementation of national indicators, diffusion of new technologies, and links across the nitrogen policy arena relevant for inter-governmental processes.
4.3 Overall demonstration of the International Nitrogen Management System (INMS) in support of understanding the Global Nitrogen Cycle to further strengthen the objectives of GPA, UNEA, OECD, UNECE ad other bodies across the emerging Policy Arena on Nitrogen. .
4.4 2/3 guidance documents specific to selected private sector stakeholders advising on assessing and presenting nitrogen management and use efficiency issues.
4.5 Presentation of INMS development to UN Environment Assembly in Yr 2, 3 & 4.
4.6 With 1% of the project resources in support of IW:LEARN: Dedicated project website connected with IW:LEARN and other GEF knowledge management systems (within 6 months).
4.7 Documented cooperation and knowledge exchange with (i) IW:LEARN including at least one functioning CoP as well as (ii) with STAP.
4.8 Participation at the International Waters conferences; at least 3 experiences notes and tracked project progress reported using the GEF5 IW tracking tool.

3.3.3 Activities, Tasks and Seven Key Aims

103. In order to achieve the broad **Outcomes** and **Outputs** identified according to the GEF project methodology, these are translated into **Activities**, which constitute the main work-packages of the Components. Each Activity leads

to one of the Outputs listed above. Within each Activity, a number of **Tasks** are identified, each of which leads to a **Task Output**, as a contribution to achieving the overall Output of the Activity.

104. In the following sections of this document the work is described mainly in terms of the Components, Activities and Outputs. The Component appendices provide further detail in the Tasks and Task Outputs (Appendices 15 to 18).

Seven Key Aims

105. Within this comprehensive structure, it is also helpful to summarize briefly **Seven Key Aims** of the project. The purpose of listing these is to show at a glance some of the most important anticipated results of the project:

1. To **develop tools and indicators, assessment methodologies and models** that can be applied at global and regional scales to assess progress in better management of the nitrogen cycle and to identify options to optimize strategies and help overcome the barriers-to-change (Component 1).
2. To apply the models to **examine flows and impacts of the global nitrogen cycle, with future scenarios** to demonstrate the multiple benefits of improved nitrogen management (Component 2).
3. To **review experience on interventions** related to the nitrogen cycle and to **identify technologies and management options** that show the best promise for net benefits across the nitrogen cycle, delivered in the form of a state-of-the-art international guidance document (Component 2).
4. To support the global analysis by **specific studies at the regional scale**, incorporating national and local experiences to **demonstrate the joined-up approach** across the nitrogen cycle showing how it can lead to multiple benefits and help overcome barriers-to-change (Component 3).
5. To combine the outcomes as a basis in the form of a **first consolidated global assessment of nitrogen** flows, pathways, impacts, mitigation and management opportunities, cost-benefit analysis and improved understanding of policy barriers and opportunities, to be published as a high level international state-of-the art (Component 2).
6. To utilize the critical mass of the Towards INMS community, combined with the tools, models, management, regional demonstrations and consolidated global synthesis to **promote a clearer public understanding and awareness** of the nitrogen cycle as a foundation for the development of more optimal policies and strategies (Component 4)
7. To work with countries and policy makers in the **refinement of the policy arena for nitrogen**, or other possible models, in order to deliver more-coherent scientific and technical support to nitrogen policy and practice development in the future (All components).

3.4 Project Components and Expected Results

3.4.1 Summary of Project Components

106. The project will build on previous GEF interventions related to understanding nutrients (e.g. Global Nutrient Foundations project) and will further strengthen the science-to-policy linkages that will aid the development of global, regional and national nitrogen management strategies. The project provides the natural next step beyond previous initiatives, which have mainly focused on component parts of the nitrogen problem. In this way the proposed project works towards the establishment of a comprehensive International Nitrogen Management System (INMS) to support future decision-making, taking account of the multiple benefits of improved nitrogen management.

107. The project will develop the system of evidence to show how actions to protect the marine environment from land-based sources of nitrogen pollution have simultaneous co-benefits for freshwater, air pollution, climate, biodiversity and soils, as well as for food and energy security. By building this gravity to protect the global commons, a much stronger transformational change in the global nitrogen cycle can be expected. At the same time, the understanding gained will provide improved insights in understanding the barriers-to-change.

108. These issues are addressed through a project structure consisting of four main components as summarized in Figure 5. This illustrates the necessary inputs as well as the high level of interaction between the four main

components, with support for project and financial management by the project coordination unit (PCU). The overall project visualization is given in more detail in Figure 6, which shows how each of the main Components is delivered through four to nine Activities. While the day-to-day management is provided by the PCU, the Project Management Board (PMB) steers the overall project. The process is supported with strategic guidance from the Stakeholder and Policy Advisory Group (SPAG), with collective group of funding organisations constituting the Project Partners Assembly (PPA). The focus of the following sections is on the Activities and Outputs of the Components. A summary of the project governance structure is given at Section 4, with full details in Appendix 10.

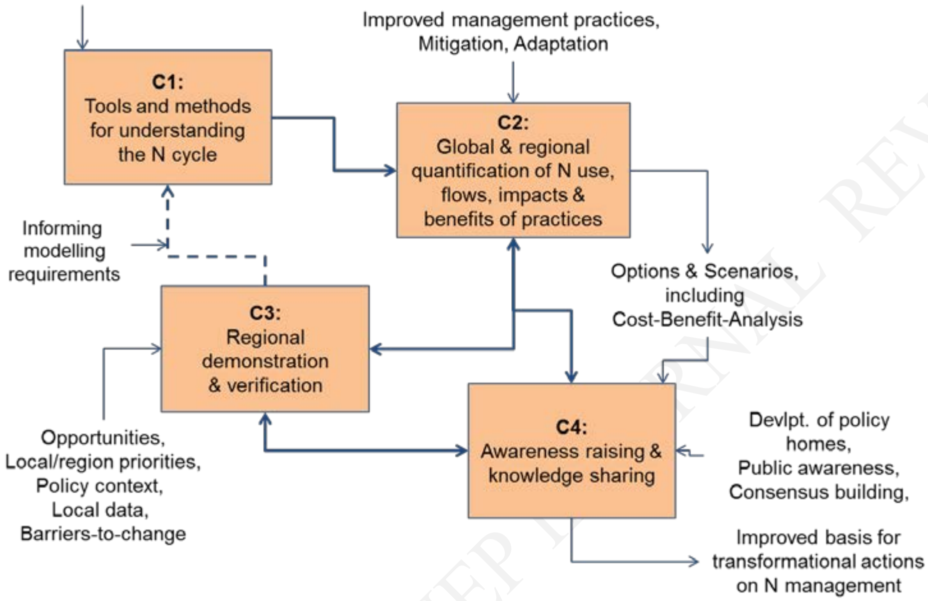

Figure 5. *Summary of the main components of the 'Towards INMS' project, inputs, interactions and outputs.*

3.4.2 Component 1

109. The purpose of Component 1 is to develop the necessary tools and approaches that form the basis for improving understanding and quantification of the global nitrogen cycle, and hence a foundation for developing the necessary interventions at global and regional scales. Component 1 focuses on establishing necessary methods, models and indicators, considering especially the datasets that are required. Its perspective crosses from biophysical dimensions, linking water systems (aquatic and marine) to terrestrial systems (including agricultural and other activities) to atmospheric systems, including emissions, transport, levels of nitrogen compounds and deposition. This biophysical perspective is complemented by the development of economic and social perspectives that are critical in understanding the drivers, opportunities and limitations to achieving better nitrogen management at global and regional scales.

110. The main elements are as follows:

1) Action to develop better indicators of nitrogen systems, including national and farm scale nitrogen budgeting approaches, a suite of nitrogen use efficiency (NUE) approaches, and the relationship between such budget, balance and efficiency indicators to effect based indicators of societal benefits and adverse environmental effects (Delivered through **Activity 1.1**).

2) Development of a threat assessment methodology, including identification of the key threats, stakeholder review and refinement, development of assessment methodology for the different threats and drafting guidance (Delivered through **Activity 1.2**).

3) Development of the methodology for combined assessment of nitrogen fluxes and distribution, considering the linkages between air, land and water, and dispersion through trade, including review of methods for different N components and different environmental compartments, leading to the preparation of guidance methodology (Delivered through **Activity 1.3**).

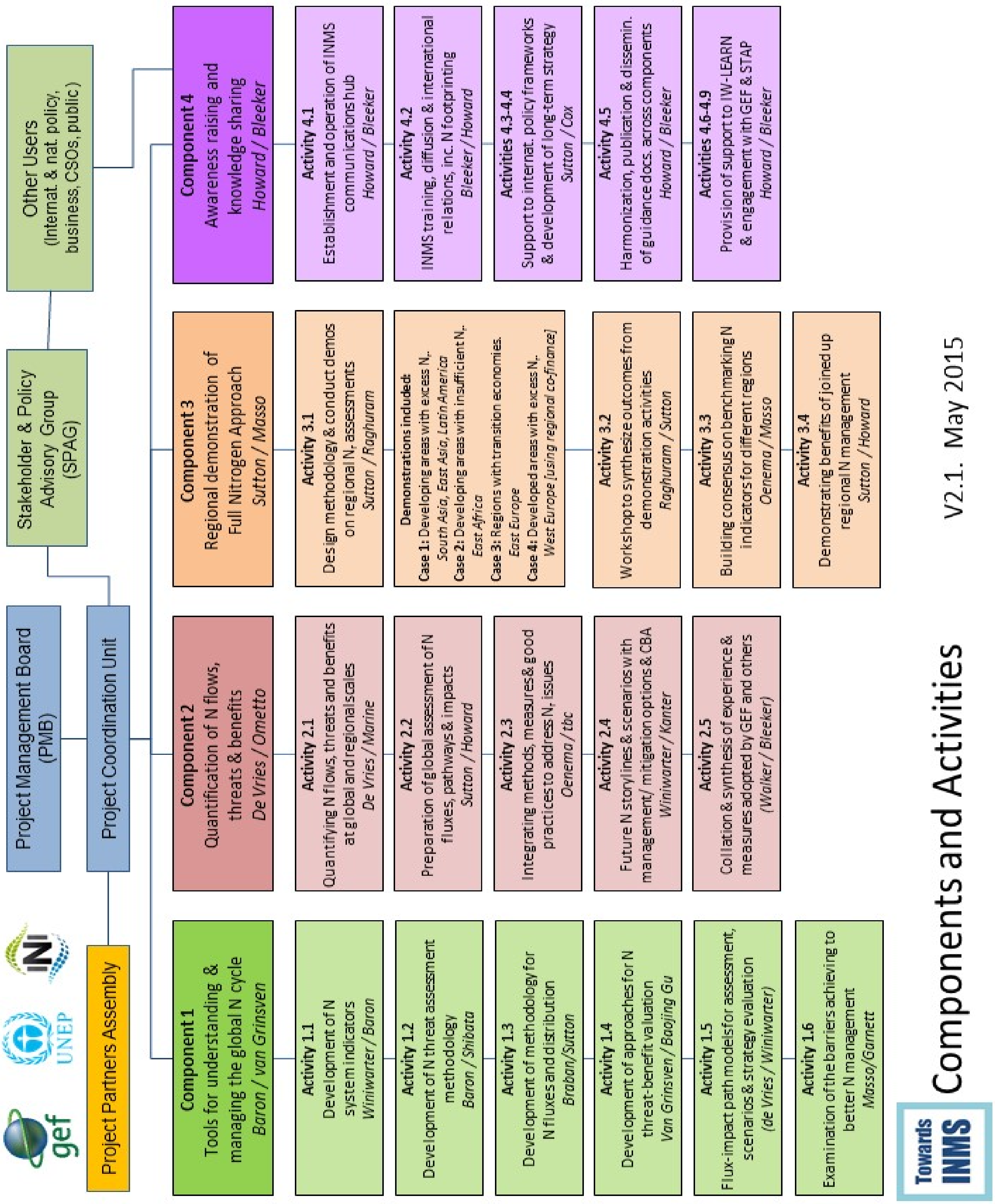

Figure 6: *Summary of the Components and Activities of 'Towards INMS'. The Activities represent groups of people working together and are directly linked to each of the project Outputs.*

4) Refinement of approaches for threat benefit valuation, including review of existing studies, refinement of methodology across contrasting economies, integration of the benefits and threats for food, health, ecosystem, climate and energy, and the valuation under future nitrogen scenarios (delivered through **Activity 1.4**).

5) Development of flux-impact path models for assessment, scenarios and strategy evaluation, including translating storylines into model requirements, review and comparison of component models, designing model framework, application of selected models in a model cluster, and demonstration of the model cluster at global and regional scales (delivered through **Activity 1.5**).

6) Examination of the barriers to achieving better nitrogen management, linking the economic, social, cultural and other factors that affect adoption of measures, examination of the barriers in food systems and in relation to sustainable consumption, and exploration of the role of a full nitrogen approach and other options to overcome the barriers (delivered through **Activity 1.6**).

111. The following table summarizes the Activities in relation to the Outputs, along-side information on Specific products (summarizing task outputs):

Table 2: *Summary of Activities, Outputs and Specific Products for Component 1.*

Activity	Output	Specific Products (summary of Task Outputs)
Activity 1.1 : Nitrogen System indicators	Output 1.1: Indicators developed for assessing full N budgets, use, levels and impacts, including N use efficiency and benchmarking. Indicators to be developed of relevance for specific stakeholders.	Guidance Documents on Nitrogen Budgeting and Nitrogen Use Efficiency approaches, and on relating level and effect indicators to budget indicators.
Activity 1.2 : Development of Threat Assessment Methodology	Output 1.2: Methodology for Nitrogen Threat Assessment.	Consultation document on key N threats. Workshop report on threat assessment methodology. Guidance Document
Activity 1.3 : Development of methodology for N fluxes and distribution	Output 1.3: Methods for determining N fluxes and distribution (water, air, land, agriculture, industry etc)	Scoping report and background document on N flux and distribution methods. Workshop report and Guidance Document
Activity 1.4 : Development of approaches for threat-benefit valuation	Output 1.4: Approaches to estimate the value of N threats and benefits	Status report identifying gaps and challenges, identification of principles for global and regional comparison. Methodology. Document on valuing threats and benefits for future scenarios
Activity 1.5: Flux-impact path models for assessment, scenarios & strategy evaluation	Output 1.5: Approach to using existing N flux/pathway models for global/regional assessments and visualisation for potential scenarios	Proposal of approach to implement scenarios and storylines for stakeholder feedback. Document and database on models and data needs. Document on criteria for N modelling cluster, modelling outputs linking N flows and effects. Report on N modelling for scenario needs
Activity 1.6 : Examination of the barriers achieving to better nitrogen management	Output 1.6: Understanding the barriers to change at all levels of society (government, private sector and civil society) including technical, financial and socio-political limitations.	Report on economic and cultural factors. Report on barriers in food systems. Report on barriers to consumption-production & behavioural change. Report summarizing options for overcoming barriers at global and regional levels.

3.4.3 Component 2

112. The purpose of Component 2 is to apply tools, methods and data to synthesize knowledge on nitrogen flows, threats and benefits in the context of the global nitrogen cycle. It will apply key inputs in the form of tools and methods developed in Component 1, together with outcomes from the regional demonstration activities of Component 3, to analyze the current status of N flows, threats and benefits. While the first target is the global scale, it will necessarily use the regional activities to illustrate regional variation in context as well as the possible solutions. Options for improved nitrogen management in different contexts will consider the multiple benefits, linking water, air, greenhouse balance, ecosystems and soils, as well as the interactions with food and energy. These elements will inform the development of storylines and scenarios of different "nitrogen futures" and how these relate to cost-benefit analysis. The work will provide key high-level outputs that will support awareness raising and knowledge sharing of Component 4. The targeted research of Component 2 therefore will help develop global policy framing for nitrogen, providing an improved basis for transformational actions on nitrogen management, globally and regionally.

113. The main elements are as follows:

1) Application of a suite of modelling tools to quantify nitrogen flows, threats and benefits at global and regional scales, including developing a shared database of inputs and model outcomes, provision of international support for regional inventory and model development, and integrated analysis to quantify present and future threats and benefits (delivered through **Activity 2.1**).

2) Preparation of a first global assessment of N fluxes, pathways and impacts, assimilating lessons from the regional demonstrations, including: scoping the structure of the consolidated global assessment, commissioning author teams, drafting and peer review, preparation of summary documents and review, publishing and distribution of the consolidated assessment. The work will draw on the outcomes of Components 1 and 3, while providing material to support the actions of Component 4 (delivered through **Activity 2.2**).

3) Integrating methods, measures and good practices to address issues of excess and insufficient reactive nitrogen, including preparation of a document on the state-of-the-art for good nitrogen management, considering different N forms and N effects. It will include workshops to develop methods that link good practices for N effects (linked to food, energy, water, air, climate, biodiversity etc) and lead to preparation of international guidance on approaches for improved management of the nitrogen cycle (delivered through **Activity 2.3**).

4) Exploration of future N storylines and scenarios with management /mitigation options and cost-benefit analysis, including review of existing N policies for different countries and regions and review of existing storylines and scenarios. It will lead to a published strategy on scenarios and storylines, together with a report on N policy options and their possible contribution to development of the Green Economy / Circular Economy (delivered through **Activity 2.4**).

5) Collation and synthesis of the experience of measures for improved nitrogen management as adopted by GEF and others, including UNEP, OECD, FAO etc in sharing and disseminating success stories including lessons learned through case studies at national and local levels. These case studies will complement and further enhance the Regional Demonstrations of Component 3 (delivered through **Activity 2.5**).

114. The following table summarizes the Activities in relation to the Outputs, along-side information on Specific products (summarizing task outputs):

***Table 3:** Summary of Activities, Outputs and Specific Products for Component 2.*

Activity	Output	Specific Products (summary of Task Outputs)
Activity 2.1: Quantifying N flows, threats and benefits at global and regional scales	Output 2.1: Quantification and assessment of the global and regional threats from excess and insufficient reactive nitrogen	Database and access to sources. Inventory expertise and models provided to support C3 demonstrations. Report on global and regional N flows, threats and benefits. Report comparing present situation with future scenarios.
Activity 2.2: Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations	Output 2.2: Detailed overview of regional/local N flux and consolidation into a global assessment of N fluxes, pathways, effects and benefits of improved N management	Scope and structure of global assessment agreed. Author teams appointed and produce draft chapters. Peer reviews provided to authors and documents revised. Documents reviewed by PPA, SPAG and other stakeholders. Report published with wide public dissemination.
Activity 2.3: Integrating methods, measures & good practices to address issues of excess & insufficient reactive nitrogen	Output 2.3: Consolidation of methods and good practices to address issues of excess and insufficient reactive nitrogen	Background documents produced for workshop on best N management practices. Basis for developing guidance linking N forms & issues, high-lighting most promising options. Workshop Report with document for review. Document finalized and published. Practice database updated.
Activity 2.4: Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis	Output 2.4: Definition of programmes & policy options for improved reactive nitrogen management at local/regional/global levels, supported by cost-benefit analysis to underpin options for the Green Economy	Report with database as input to workshop on N policies, storylines & scenarios. Published strategy on storylines and scenarios. Report on Policy options and contribution to Green Economy.
Activity 2.5: Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient reactive nitrogen	Output 2.5: Compendium summarizing the state of knowledge, experience and measures adopted by GEF (and others) gained from addressing the issues of excess and insufficient reactive nitrogen	Database and summary of GEF N related actions and those adopted by others. Synthesis and database on N measures as contribution to global assessment.

3.4.4 Component 3

115. This purpose of Component 3 is to establish targeted research demonstrations on the nitrogen cycle at a regional scale for each of the main world regions. The approach is to demonstrate how a joined up approach to nitrogen management can catalyse stronger action for a cleaner environment (water, air, greenhouse gas, ecosystems, soils) and improved food and energy production simultaneously. In essence the hypothesis is that a joined up approach across the nitrogen cycle can deliver multiple co-benefits that will strengthen the case for transformational change. The choice of regional scale reflects the need to link between local and global scales, to share regionally specific lessons and to work in partnership with regional intergovernmental and other international processes.

116. The main elements are as follows:

1) Design common methodology to conduct regional demonstrations of nitrogen flows, priorities, mitigation options, co-benefits, success stories, barriers-to-change and ways of overcoming barriers to change (delivered through **Activity 3.1**).

2) Conduct the regional demonstrations to refine regional nitrogen assessments and improve understanding of regional N cycle (delivered through **Activity 3.1**). (This is the main activity – replicated for several different demonstration conditions across the world.)

3) Use a workshop to synthesize outcomes from demonstration activities focusing on reducing adverse N impacts & maximizing co-benefits (delivered through **Activity 3.2**).

4) Build consensus on benchmarking N indicators for different regions and systems, linking between the regions and global scale analysis (delivered through **Activity 3.3**).

5) Refine the regional approach to demonstrate the benefits of joined up N management, leading to concrete plans of how a perspective from the N cycle can be embedded in the future activities of GPA and other national programs and international conventions (delivered through **Activity 3.4**).

117. The following table summarizes the Activities in relation to the Outputs, along-side information on Specific products (summarizing task outputs):

Table 4: *Summary of Activities, Outputs and Specific Products for Component 3.*

Activity	Output	Specific Products (summary of Task Outputs)
Activity 3.1: Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle	Output 3.1: Four demonstration cases deliver conclusions refining approaches to regional assessments and improving understanding of regional N cycle. (Four cases as described in the main text below)	Main N flows quantified by source sector & pathway; better data access & understanding with estimated uncertainties. Key N benefits/threats quantified & regional priorities identified. Basis to compare regions in relation to agreed indicators. Document on N mitigation/ management options identifying win-wins & regional priorities. Synthesis of current local/regional efforts including success stories, full N approach, and approaches to overcome barriers. Global N scenarios informed by regional evidence.
Activity 3.2: Workshop to synthesize outcomes from demonstration activities focusing on reducing adverse N impacts & maximizing co-benefits	Output 3.2: Assessment and quantification of impacts from piloting activities to reducing negative impacts from poor N_r management, while demonstrating the co-benefits for other issues	Advance background documents according to common template. Basis for synthesis publication agreed. Publication on synthesis from the regional demonstrations.
Activity 3.3: Building consensus on benchmarking N indicators for different regions and systems	Output 3.3: Refined benchmarking of indicators for different regions and nutrient flow systems	Scoping paper on benchmarking N indicators from regional perspectives. Joint report (under A2.3) informed with regional perspectives on benchmarking.
Activity 3.4: Refinement of regional approach to demonstrate benefits of joined up nitrogen management	Output 3.4: Plans for inclusion of agreed approach to N cycle assessments accepted by GPA and others	Briefing document for testing with stakeholders. Revised document on common approach, while recognizing regional priorities. Recognition of N cycle approach with GPA and other international frameworks.

118. The regional demonstrations make the link to the global scale while incorporating examples and lessons by integrating with existing and planned activities at the local level. Four cases are considered in order to be representative of the wide range of situations globally:

Case 1: Developing regions with excess reactive nitrogen (South Asia, East Asia, Latin America)

Case 2: Developing Regions with insufficient reactive nitrogen (East Africa),

Case 3: Transition economies with excess reactive nitrogen (East Europe).

Case 4: Developed regions with excess reactive nitrogen (West Europe). It is expected that additional input from a North American Demonstration may also be developed during the course of Towards INMS.

119. Cases 1 to 3 will be addressed with financing support from GEF, while Case 4 will be addressed based on financing from other sources to the extent that this becomes available. Review during the PPG phase has shown that the distinction between these cases is not necessarily a simple one. For example Latin America includes areas with both excess and insufficient N_r, while even East Africa includes areas with local excess N_r leading to environmental problems. Nevertheless, by covering all four cases it is ensure that the full diversity of regional issues is considered while building the critical mass necessary to establish a robust global approach.

120. The criteria for selecting the locations to implement Cases 1, 2 and 3 are described and evaluated in Appendix 17. This led to the proposal to further develop the East Asia, South Asia, Latin America, East Africa and East Europe demonstration studies, which was agreed by the full partnership at the First INMS Plenary Meeting (Lisbon, April 2015). It was concluded (see Appendix 17) that it was not possible currently to further develop proposed demonstration regions in the East Baltic and in Central Asia. Further capacity building would be needed (especially in Central Asia), for possible consideration of demonstrations in future INMS related activities. The involvement of selected experts from these regions in 'Towards INMS' meetings could serve to prepare the ground for such demonstrations in the future. The following locations were selected (Appendix 17):

Case 1: Regions with excess reactive nitrogen loss.

East Asia (China, Japan, including engagement with Philippines and South Korea);

South Asia (India, Bangladesh, Sri Lanka, Nepal, potentially including Pakistan and Myanmar if additional resources can be made available from other sources);

Latin America – La Plata catchment (Brazil, Paraguay, Uruguay, Argentina, Bolivia)

Case 2: Regions with insufficient reactive nitrogen.

East Africa - Lake Victoria catchment (Kenya, Uganda, Tanzania, Burundi, Rwanda);
(**Latin America** is also relevant for this case.)

Case 3: Regions with transition economies.

East Europe –Dniester/Prut/Lower Danube. (Ukraine, Moldova, Romania). This area also provides the opportunity to engage with and develop improved scientific and environmental cooperation with Russia and Belarus.

[Central Asia: While there is not yet sufficient foundation to conduct a Central Asia demonstration, it is proposed to develop the links under the outreach of Component 4 in order to prepare the way to allow a demonstration here in a future project.]

Case 4: Developed countries with excess reactive nitrogen loss.

West Europe – Atlantic Coast (Spain, Portugal, France, UK, Belgium). This may be included to the extent that external funding sources are available.

The inclusion of other areas, e.g. in **North America** must be dependent on other funding opportunities and will be reviewed during the project inception phase.

121. The outcomes of the Component will feed specifically to support progress in improved nitrogen management for environment, health and food, deliver documentation to support the global consolidated synthesis, and contribute to the goals of regional agreements as outlined in Section 2.

3.4.5 Component 4

122. The purpose of this component is to support all internal and external communication and knowledge exchange in the project. Key to the success of this targeted research activity is the uptake of emerging results by other partners, ongoing engagement and exchange of ideas with stakeholders to ensure that tools and products are fit for purpose and communication of all results in the most effective way. As such, Component 4 will be informed by the key high-level outputs from the other three components and the needs and practicalities of partners and external stakeholders. A solid foundation will be built for internal communication within the project, e.g. newsletters, annual meetings and a dedicated members area of the web portal. Information and datasets within the project will be organized and made accessible through the web portal and INMS database system. This foundation will be paired with activities to engage with the N stakeholder community on a variety of levels, using a variety of approaches, including initiating a network of 'Nitrogen Champions'. Training will be provided to regional and national experts. The links between INMS, GPA and other relevant intergovernmental process will be made along with considering the long-term needs and implications of an INMS. Integrated guidance emerging from the project will be harmonized and communicated. Channels for knowledge exchange with the general public will also be explored and exploited, including further investigating N footprinting and developing audience relevant communication products for dissemination through the website.

123. The main elements are as follows:

1) Establishment of the INMS communications hub and its ongoing operation, including a web portal, the INMS database, internal project communication and press and public engagement functions (delivered through **Activity 4.1**).

2) Training in nitrogen measurement, modelling and mitigation techniques provided to regional and national experts, development of international engagement on linking intergovernmental processes, and sharing of experience on the use of N footprinting to increase public awareness (delivered through **Activity 4.2**).

3) Development of synthesis to demonstrate INMS in support of GPA objectives, co-ordination of the inputs from INMS into other policy processes, and development of a long-term strategy for INMS, including potential policy homes and financing options (delivered through **Activities 4.3 and 4.4**).

4) Harmonization and publication of guidance documents on 'N budgets efficiency and benchmarking', 'threats fluxes and distribution methods', 'N measures and good practices' including information on barriers and successes (delivered through **Activity 4.5**).

5) Provision of support to IW-LEARN and engagement with GEF and STAP, including: giving financial support to IW:LEARN, connecting INMS website with IW-LEARN, cooperating with IW-LEARN and STAP in development of Community of Practice (CoP), participate in International Waters conferences and prepare INMS Experience Notes (delivered through Activities 4.6 to 4.9).

124. The table on the next page summarizes the Activities in relation to the Outputs, along-side information on Specific products (summarizing task outputs):

Table 5: *Summary of Activities, Outputs and Specific Products for Component 4.*

Activity	Output	Specific Products (summary of Task Outputs)
Activity 4.1: Establishment and operation of INMS communications hub	Output 4.1: Local, national and regional expertise to address N_r issues increased and contributes to improved GPA and other decision making at the regional / global levels	INMS web portal operational and active. Information on N flows, outcomes, indicators shared. Information exchange across the project, including newsletter & other products. Key messages for press, plus public engagement tools.
Activity 4.2: INMS training, diffusion and international relations, including nitrogen footprinting	Output 4.2: Training for regional/national experts to sustain and enhance understanding of global N cycle implementation of national indicators, diffusion of new technologies, with links between GPA and other inter-governmental processes	Training provided to regional & national experts including diffusion of new technologies. Increased engagement by countries on links between GPA & other intergovernmental processes. Workshop interventions, information on INMS portal and popular publications.
Activities: 4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & development of long-term strategy	Output 4.3: Overall demonstration of the International Nutrient Management System (INMS) in support of understanding the Global Nitrogen Cycle to further strengthen the GPA objectives and international nitrogen policies. Output 4.4: Presentation of INMS development to UN Environment Assembly in Yrs 1 & 3	Science support to GPA & regional processes showing the benefits of N cycle approach. Contributions of INMS to global/international policy processes including UNEA. Proposal developed for how INMS can contribute to the policy arena for nitrogen.
Activity 4.5: Harmonization, publication & dissemination of guidance documents across components.	Output 4.5: Guidance documents specific to selected stakeholders advising on assessing and presenting nitrogen management and use efficiency issues	Guidance documents published on: a) N budgets, NUE & benchmarking, b) N threats, fluxes & distribution, c) N measures & good practices including barriers/successes.
Activities 4.6-4.9: Provision of support to IW-LEARN & engagement with GEF & STAP.	Output 4.6: With 1% of the project resources in support of IW:LEARN Output 4.7: Dedicated project website connected with IW:LEARN and other GEF knowledge management systems (within 6 months). Output 4.8: Documented cooperation and knowledge exchange with (i) IW:LEARN including at least one functioning CoP as well as (ii) with STAP. Output 4.9: Participation at the International Waters conferences; at least 3 experiences notes and tracked project progress reported using the GEF5 IW tracking tool.	Required contribution to support IW:LEARN provided. INMS website connected with IW:LEARN. Documented knowledge exchange with IW:LEARN & STAP, including Community Of Practice. Experience notes produced. Project tracked using tracking tool.

3.5 Intervention logic and key assumptions

125. The 'Towards INMS' project is developed under the logic that a global approach to managing the nitrogen cycle will mobilize a stronger 'gravity of common cause' that can help overcome barriers-to-change. This can be aided especially by linking the threats of nitrogen pollution in freshwater and coastal environments with other environmental challenges, including air quality, greenhouse gas emissions, stratospheric ozone depletion and effects on biodiversity, as well as with the benefits of improved nitrogen use. As explained in the baseline analysis, too little attention to the science of the nitrogen cycle has been compounded by a fragmented approach to policy development and implementation.

126. With this rationale, the logic of the Towards INMS intervention can be summarized as follows, including key assumptions in bold font:

a. That **targeted research on the nitrogen cycle is needed** to provide the foundation to understand the interlinkages between reducing the problems of nitrogen in waters and coastal zones, and how future management approaches could deliver simultaneous quantified co-benefits (C1).

b. That **consensus development is needed on the most appropriate tools and metrics** to describe the nitrogen cycle, especially in relation to assessing global, regional and local performance linked to the different nitrogen threats and benefits (C1).

c. That **efforts need to be placed toward both improving the basis for cost-benefit analysis** for nitrogen **and the quantitative modelling tools** as a basis to support identification and prioritization of threats and benefits and how these vary regionally, as well as to demonstrate where co-benefits may occur by virtue of linkages through the nitrogen cycle (C1, C3).

d. That an **improved understanding is necessary to the barriers-to-change**, that considers both the generic challenges and can informed by regional demonstration engagement (C1, C3).

e. That the **application of tools to show the main flows and impacts of the nitrogen cycle at global and regional scales is necessary** for delivering a global assessment of the current state of impacts and the opportunities for mitigation (C2, C4).

f. That **there are many available management and mitigation methods**, practices and technologies to improve management of the nitrogen cycle, and that specific **attention to the interactions across the nitrogen cycle will help provide clear guidance** on the most effective methods that offer multiple-benefits (C2, C3, C4).

g. That the **establishment of future scenarios provides key information to support policy makers** in developing shared views of the possible actions that may be taken, and that this is essential information for an international nitrogen management system (C2, C3, C4).

h. That **there is information available from previous GEF interventions and others** (e.g. national case studies) that can be combined with information from specific regional demonstrations to support the global assessment and sharing of best practices (C2, C3).

i. That **a major global assessment** that brings together the leading scientific understanding with robust information on the nature and extent of threats and the benefits of taking action **can provide a high visibility product to attract the attention of the world's press and governments** as they consider how to respond (C2, C3, C4).

j. That the **global assessment needs to recognize the balance between the identification of possible shared goals at the global level and the importance of identifying local and regional priorities**, as informed by evidence at the regional and local scales (C3, C4).

k. That sufficient **resources need to be reserved to allow effective communication** across a diverse network of partners, to ensure high quality delivery of products and to enagege externally with diverse stakeholders, including governments, press, international frameworks etc. (C4).

l. That the current policy response to nitrogen is highly fragmented and sub-optimal, so that **a more coherent joined up view will help strengthen the delivery of several policy processes** connected to nitrogen (C4).

m. That the science engagement of **Towards INMS will stimulate policy makers to think about the most optimal way of addressing the nitrogen cycle**, and that the developing narrative of the 'nitrogen policy arena' provides a useful starting point to stimulate thinking by policymakers as well as the development of a long term policy home INMS (C4).

3.6 Risk analysis and risk management measures

127. The following main risks are identified for the 'Towards INMS' project, for each of which a risk mitigation strategy is identified:

Table 6: *Risks and mitigation strategies. L=Low risk; M=Medium risk; H=High risk.*

Risk	Rating	Mitigation Strategy
Failure to agree on common global approaches for indicators and models (C1)	L	Development and utilization of inclusive networks of scientists and policy makers to ensure that demand for relevant information is met by the supply of appropriate indicators
Limited country buy-in (C1-C4)	L	Working with the GPA and other international frameworks (e.g. CLRTAP, UNECE Water Convention, HELCOM, OECD etc.) plus Industry (e.g. International Fertilizer Manufacturers Association, Companies, Farmer Organizations) and NGOs (e.g. WWF etc.) to facilitate the global dialogue on nitrogen. Ensure regular contributions on nitrogen appear in the Popular Press, TV and Radio.
Limited GPA buy-in (C1-C4)	L	Working with the GPA to facilitate the global dialogue on nitrogen. Active demonstration at the GLOC and GPA Bureau meetings of how the INMS can support GPA objectives.
Limited willingness by countries / stakeholders to develop strategies for problems of too much or too little N_r (C2-C4)	M	Close co-operation with countries and fertilizer industry will assist with mitigating impacts of insufficient or too much reactive nitrogen.
Impact from climate change and variability on conclusions	M	Specific attention to include effects of regional climate variation and global climate change will be examined by models.
Inadequate communication between science assessment and policy development processes	M	Improved awareness and dialogue between researchers and policy makers through the development of INMS, which is specifically targeted to build the process of science-policy support.
Slow development of the global policy 'home' for N_r (Track 1) to take up the results of the project (Tracks 2 and 3).	H	The project will work with existing mechanisms, in the first instance with GPA, which has already indicated its priority concern for nutrients, complemented by engagement with the UN Environment Assembly, CBD, LRTAP, regional water conventions, OECD, business groups, civil society etc. This will develop the network of key 'nitrogen champions' to ensure that the outcomes of the project are used.
Interactions with other stressors	M	The development of N cycle tools will include assessing linkages with other global stressors interacting with N_r.

3.7 Consistency with national priorities or plans

128. The development of the International Nitrogen Management System through this project will assist with improving the knowledge-base available and in an easily accessible manner to support coordinated action at various levels.

129. It is fully consistent with the goals of the GPA, which especially address nutrient-related issues at global, regional and national levels, as well as with other intergovernmental processes. This is consistent with the Manila Declaration of the GPA IGR-3 (January 2012) through which 64 governments and the European Commission agreed "to step up efforts to develop guidance, strategies or policies ….. so as to improve nutrient use efficiency …, and to mitigate negative environmental impacts through the development and implementation of national goals and plans…".

130. The INMS Project will assist the strengthening of national and local capacities to implement appropriate nitrogen management approaches. At the same time it will support national governments and regional authorities to assess and report reactive nitrogen loads and impacts to the GPA, while delivering a more coordinated approach in cooperation with other bodies, including especially the CBD, LRTAP, OECD, as well as developing links with the Vienna Convention (Montreal Protocol), UNFCCC, IPCC, IPBES and others. The approach has cross-cutting relevance to the Sustainable Development Goal (SDG) process and will also contribute to activities on that demonstrate The Economics of Ecosystems and Biodiversity (TEEB).

131. The outputs of this project will also assist regional water conventions (e.g. Danube/Black Sea Conventions, Cartagena Convention and protocol on Land-Based Sources of Marine Pollution, US-Canada International Boundary Waters Treaty and International Joint Commission, US-Canada Air Quality Agreement, MAP, HELCOM, UNECE Transboundary Water Convention etc.) to develop regionally specific management plans for reactive nitrogen. Similarly, the approaches to be developed and harmonised on an international basis (e.g. nitrogen budgets, nitrogen use efficiency indicators including components and NUE of the full chain, including refinement of system benchmarks) is fully consistent with the agreement of the UNECE Gothenburg Protocol under the LRTAP Convention for countries to establish and monitor national nitrogen budgets.

132. As the project progresses over the proposed 4 years, there will be substantial potential to refine the links with other policy domains, showing how nitrogen management practices can support other needs. These include demonstrating the links between improved NUE, reduced marine pollution and reduced nitrous oxide (N_2O) emission (relevant for the UN Framework Convention on Climate Change and the Montreal Protocol) and the links between improved NUE, reduced marine pollution and reduced ammonia (NH_3) emissions, relevant for the LRTAP Convention. Similarly, improved nitrogen management will contribute significantly to meeting food goals identified by FAO.

133. Demonstrating how key actions to protect the marine environment will simultaneously benefit these other policy domains and will help build the momentum that is essential for a more-effective protection from pollution of the global marine environment.

134. This Targeted Research Project addresses IW objective 3 'to support foundational capacity building, portfolio learning, and targeted research needs for ecosystem-based, joint management of transboundary waters' that will lead to outcomes enabling countries to develop and implement science-based nitrogen management strategies. The Project is also consistent with, and supportive of, IW objective 1 'Catalyse multi-state co-operation…'

135. The INMS Project responds to STAP recommendations in 'Hypoxia and Nutrient Reduction in the Coastal Zone' for UNEP to take the lead in developing research activities to further understand and assist with developing policies to mitigate problems of coastal hypoxia.

136. By addressing the problems caused by excess reactive nitrogen on coastal waters and fish stocks in particular, and by supporting good management practices when other regions increase their use of fertilizers, the project will

help ensure food security and environmental sustainability, implementation of the Sustainable Development Goals. Furthermore, such actions will also contribute in achieving CBD Aichi Target 8 which calls for action to reduce pollution, including from excess nutrients, to levels that are not detrimental to ecosystem function and biodiversity. In regard of sustainable development goals, the Rio+20 outcome document "Future We Want" noted "with concern that the health of oceans and marine biodiversity are negatively affected by marine pollution, including marine debris ...... and **nitrogen-based compounds**...." (para 163).

137. This project will further assist other GEF focal areas, specifically Land Degradation (LD) and Biodiversity (BD), by demonstrating how improved nitrogen management practices can simultaneously provide quantified co-benefits for these other focal areas. This will be supported by cost-benefit analysis, thereby building additional support to implement the necessary nutrient management actions. In the same way, there is also the scope to extend the analysis of co-benefits for climate change and air quality benefits for human health (especially for links to mitigation of N_2O and NO_x emissions).

138. The Towards INMS PPG phase is already developing partnership with OECD as a forum to bring together country-case studies, and build consensus on the development of national nitrogen strategies and plans. A joint workshop between the UNECE Task Force on Reactive Nitrogen (TFRN), which forms a regional contribution to INMS, with OECD will take place in May 2016 to further refine this development, including a progress update on INMS development.

3.8 Incremental Cost Reasoning

139. Through targeted research to improve the understanding of the global nitrogen cycle, this project is expected to deliver improved socio-economic benefits to a range of stakeholders, including:

- For farmers through better management policies and practices contributing to food security ;
- For coastal communities, by supporting improved (long-term) fisheries, where currently impacted by hypoxic waters;
- For citizens across the world, by improving overall environmental quality through improved water quality, air quality and reduced greenhouse gas emissions, as a result of better N management;
- For communities economically dependent on biodiversity, by improved revenue from tourism as a result of management policies and practices to reduce nitrogen deposition and coastal hypoxia.

140. A key innovative part of the project will be to include cost/benefit estimates of multiple externalities related to nitrogen, which will, for the first time, demonstrate the multi-focal benefits of a joined up approach (including links between water quality, biodiversity, greenhouse gases, air quality etc.).

141. The GEF and other donors have supported considerable research and supported measures to mitigate the impacts of nutrients over the last 20 – 30 years. This project represents the first collaborative activity to deliver an International Nitrogen Management System (INMS) that will combine multiple sets of information from different sectors and integrate reactive nitrogen across the environmental compartments. By making these connections between the protection of International Waters and other benefits and threats, the project will establish a major leap forward, providing the basis for transformational change in global and regional management of the nitrogen cycle.

Business as Usual

142. Currently the intentional and unintentional release of nitrogen to the environment has dramatically altered the global nitrogen cycle. In addition to emissions to the atmosphere and inputs to soils, surface and groundwater, there has been a large increase in nitrogen flows in rivers and submarine groundwater discharge to coastal waters

through much of the world.[48] Approximately 20% of nitrogen release comes from fossil fuel use, with the remainder from agriculture. But the efficiency of nitrogen use in food production is low: on average more than 80% of the nitrogen applied to fields is lost to the environment.[49] This inefficiency is compounded by an increasing demand for meat and dairy products commensurate with growing economic security in many countries. Crops are increasingly fed to livestock, especially monogastrics, to satisfy this increasing demand. About 30% of the global arable land is currently used to produce animal feed, with a comparable amount of nitrogen fertilizer application. The crop-livestock production system is the single largest cause of human alteration of the global nitrogen cycle.[50]

143. A Business as Usual (BAU) scenario assumes a world in 2050 with increasing human population, increased economic growth, increasing per-capita consumption of meat and dairy. This scenario causes increased releases of nitrogen to the environment and increased adverse impacts.[51] There are important regional differences, however. Industrialized countries are expected to become more efficient in their use and recovery of nitrogen while developing countries will increase agricultural productivity, but at the cost of reduced nutrient use efficiency and increased losses to the environment.

144. Under the BAU scenario damage to surface, ground and coastal waters will worsen, leading to increased occurrences of harmful algal blooms, hypoxia or dead zones, loss of fisheries and increased human health impacts. 'Towards INMS' will quantify the cost-benefit effects of alternative food and energy scenarios on regional and global nitrogen cycles with the intention of informing future nitrogen policy development. Both concepts and empirical data for current cost-benefit assessments can and will be improved through 'Towards INMS'.

The Cost Increment of INMS for GEF

145. The integrated nitrogen assessment approach in 'Towards INMS', combined with nitrogen cost-benefit assessment, provides consistent information about current impacts of food and energy production and consumption on the aquatic and wider environment. By also expressing impacts in the universal language of loss or gain of ecosystem services and loss or gain of welfare (in economic or human health units), information will help to improve the debate and cooperation between states or between economic sectors for collective management of large water systems while providing benefits for environment, food production, economic development, community health, and regional stability (source GEF-5 IW strategy, 2011). It may stimulate identification of transboundary solutions, interventions and investments, particularly for related to improved nitrogen management in agriculture and treatment and recycling of nitrogen in wastewater.

146. Comparison of cost and benefits of current nitrogen use and emissions, for BAU projections and for various abatement scenario's (like the recently developed Shared Socio-economic Pathways, SSPs), will further support identification of transboundary and trans-sector solutions for improved water quality while maintaining food security, a viable agricultural sector with improved nitrogen resource efficiency. 'Towards INMS' thus will help GEF to remove current barriers between the agricultural sector and the public water sector to find comprehensive and socio-economically inclusive solutions that prevent a further degradation of water and agricultural systems around the globe and instead direct human activities and institutions toward sustaining multiple uses of the soil and water resource. This will be one of the building blocks for the GEF goal to implement a range of policy, legal, and institutional reforms and investments contributing to sustainable use and maintenance of ecosystem services.

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[48] Beusen, A.H.W. et al. (2013) Global land–ocean linkage: direct inputs of nitrogen to coastal waters via submarine groundwater discharge. *Environmental research letters* **8**(3), p.034035.

[49] Our Nutrient World (2013).

[50] Bouwman, L. et al. (2013) Exploring global changes in nitrogen and phosphorus cycles in agriculture induced by livestock production over the 1900–2050 period. *Proceedings of the National Academy of Sciences* **110**(52), pp.20882-20887

[51] Bouwman, L. et al. (2013).

147. The increment of the GEF contribution will lead to the planned integrated INMS, and through the planned use of expert networks and research will benefit the global / regional understanding of reactive nitrogen. At the same time it will assist with strengthening research and management capacity in key developing regions facing major nitrogen challenges.

148. Further details on the incremental cost analysis can be found in Appendix 3.

3.9 Sustainability

149. 'Towards INMS' is putting in place for the first time the basis to establish an international support system for global nitrogen policy and practice improvement – the International Nitrogen Management System (INMS). The sustainability of this concept will depend fundamentally on the success of the 'Towards INMS' process and the extent to which stakeholders (governments, international frameworks, science community, business, practitioners, CSOs) find that the process meets its objectives in delivering appropriate scientific support for future decision making.

150. To ensure this sustainability, INMS will need to:

a. **Continually innovate** to develop a strong vision, supported by an effective public communications strategy

b. **Listen** to the needs of governments and other stakeholders

c. **Emphasize delivery of the key high-level outputs** that are needed to deliver the main elements of support for the INMS process

d. **Deliver the work to a high international standard**, demonstrating INMS as the leading source of authority for science support management of the global nitrogen cycle.

e. **Be nimble in decision making** in order to grasp opportunities and to respond to rapidly changing needs within the policy environment.

f. **Continue to bring the nitrogen challenge to a higher level** of decision making a combination of well-focused contributions to international policy processes and by effective communication with journalists through press, Radio, TV and other media.

g. **Demonstrate clear solutions and the benefits of those solutions**, providing convincing evidence of how a joined up approach to the nitrogen cycle can deliver multiple quantified benefits and help overcome the barriers-to-change.

151. The innovation of 'Towards INMS' is primarily through developing connections between the marine environment and the coupling with other food and energy security and environmental benefits of improved nitrogen management. By linking experts from different disciplines and regions, and taking experience from best practices in support of international frameworks, the International Nitrogen Management System (INMS) will provide a key resource for policy makers and management practitioners. The project will enable new multi-focus future scenarios to be evaluated providing management guidance, technical and management capacities which will be strengthened in developing regions to address the issues of reactive nitrogen.

152. Significant business opportunities in the private sector can be anticipated through improved nitrogen management. Currently around 120 million tonnes of N_r fertilizer are manufactured, worth around US$ 120 billion annually. This can be combined with another $60 billion worth of N_r acquired through biological nitrogen fixation and $40 billion worth of N_r produced in combustion processes. The substantial value of the nitrogen resource points clearly to the business benefits of improving efficiency while reducing wasteful N_r polluting losses. The proposal therefore includes specific attention to the development of innovative approaches, including the active involvement of the OECD and business groups.

153. The combination of global analysis, regional case studies and examination of both technological and consumption based options will provide a key resource to build critical mass on addressing the global nitrogen challenge. The work will provide key inputs to global organisations, conventions and initiatives, such as the GPA, CBD, LRTAP, FAO, WMO etc., allowing the synergies between their different interests to be developed. The benefits of having strengthened capacity in developing regions will be an important legacy to future global and regional nitrogen management strategies, enabling assessments and management responses to both excess and insufficient reactive nitrogen.

154. Finally, the GEF contribution will be an important catalyst for further understanding and managing all nutrients, in cooperation with the GPNM. Through the effective establishment of the INMS, lessons will be learnt that can be applied to other nutrients (notably phosphorus), potentially leading in due course to an overall nutrient management system. Reports from the project combined with the working INMS system and feedback from the policy and practice communities will provide a solid foundation to inform the development of future GEF activities, especially in the transition to GEF 6 and the emerging emphasis on a multi-focal or trans-focal area approach. In this sense the present INMS proposal can be seen as preparing the way for the aspirations of GEF 6.

3.10 Replication

155. Replication is relevant in several aspects of 'Towards INMS' as the project crosses between multiple scales:

156. **Experimental Replication**: Although experimental studies are not the prime focus of the GEF grant for 'Towards INMS' a substantial resource is made available by partner co-financing that includes experimental studies. Such experimental studies provide valuable information to support the evidence synthesis of the project, ranging from studies on the adverse impacts of N_r in the environment to those which address how improved management practices can deliver multiple quantified co-benefits for food, energy and environment. Attention to replication issues will be given to support the development of research standards, especially in the Threat Assessment Methodology the Methodology of N fluxes (Component 1) and in evaluation of practices that optimize nitrogen management (Components 2 and 3).

157. **Regional Replication**: Component 3 is deliberately designed to refine and implement a replicated approach to regional demonstration of improved nitrogen management across the nitrogen cycle. While allowing for specific regional aspects to be emphasized, the PPG phase has provided for a degree of standardization in the regional demonstrations, allowing greater power in the planned results through replication. For example, by ensuring that common information is collected and common terms calculated, a much clearer comparison of the regions can be made. This will mean that the messages that emphasize regional differences will be much more strongly justified from the evidence collected.

158. **Policy Process Replication**: This is not strict replication, but it is worth taking seriously that different policy processes have different character associated with their purpose, origin, historical evolution etc. This means that it is of great benefit for scientist in INMS to continue to work with a wide variety of different policy processes. In this way, a much stronger feel can be developed of what make for successful policy making, and what hinders it. These points are highly relevant as the discussion on the 'nitrogen policy arena' continues into the project Inception Phase. The multiple impacts of nitrogen put nitrogen scientists focused on providing international policy support into the rare position of being able to see across several policy processes and use the lessons from this in engaging with policy makers to develop the optimal character of the nitrogen policy arena.

3.11 Public awareness, communications and mainstreaming strategy

159. As outlined under Sustainability (3.11) above, developing public awareness in relation to the nitrogen cycle is a key objective of 'Towards INMS'. The foundation must be a strong set of key outcomes emerging from Components 1-3, while significant resource is allocated in Component 4 to mobilize these outcomes to develop public awareness.

160. One of the first tasks in the project will be the development of project communication strategy. This will be developed by the PCU for agreement and presentation to the PMB, SPAG and PPA. Feedback will be used to refine the strategy. Where such feedback results in a proposal to amend the priorities for resource allocation, this will be presented by the EA to the IA for approval, subject to reaching agreement on which tasks will be replaced by others.

161. INI has been highly successful in mobilizing public and policy awareness of nitrogen over the last five years. This has come about as a result of a combination of a) developing and delivering key science products that are suitable to engage policy and the public, b) engaging policy audiences in the development and dissemination of these products and c) engaging the press in these outcomes at a high level. The report 'Our Nutrient World' prepared under the lead of INI for GPNM and UNEP is an example of a clear focused product, as is the recent report 'Nitrogen on the Table', with both receiving wide press and policy coverage. Similarly, the Barsac Declaration (on nitrogen and the demitarian diet), developed by the NinE and COST 729 programmes, now features in a new dictionary of gastronomy: '*Eatymology*' (where 'Demitarian' appears between 'Crop Swap' and 'Drunkorexia'). These examples illustrate how different narratives can be used to mainstream nitrogen science for different audiences.

162. The Component 3 regional demonstrations provide another important route for mainstreaming improved understanding of the nitrogen cycle. Here a different strategy is expected to be applied for different regions, meeting the needs of key stakeholders. For example, in agricultural contexts, the message that reducing nitrogen pollution can save farmers money in fertilizer inputs is an extremely powerful message. For another audience again the buzz word is the Circular Economy. There are many different ways to 'sell' the importance of nitrogen.

3.12 Environmental and social safeguards

163. The proposed project includes: a) scientific development of measurements and models, b) science synthesis and application, c) research demonstration activities including engagement with local stakeholders and d) awareness raising and knowledge sharing. As such there are no specific safeguards needed that relevant to the project, beyond good office and travel practices (reducing water, energy, paper use, making full use of telephone and video conferencing facilities, appropriate catering for meetings, using ground-transportation rather than air-transportation where possible etc).

164. The 'Towards INMS' project engages with local stakeholders through both analysis of barriers-to-change (Component 1) and examination of the options for better field use and management of nitrogen (Component 3). By working with reputable organizations in existing and planned interventions 'Towards INMS' will ensure that appropriate social safeguards are in place at the partner organisations, who will assume their own legal responsibilities for the work undertaken.

165. Where these points are relevant in 'Towards INMS', this will be handled by consulting partners receiving funds through a project contract for specific tasks, where they will sign an appropriate declaration to confirm that that they meet the social and environmental requirements of their own country and organisation.

Section 4: Institutional Framework and Implementation Arrangements

4.1 Project Level Decision Making and Planning

166. The overall project governance and internal communication flows within the 'Towards INMS' project are summarized in Figure 7. General oversight of project activities will be undertaken by the **Project Management Board (PMB)**, which will allow project-level communication between the **Component Leaders**, the **Project Co-ordination Unit (PCU)**, the **Executing Agency (EA)** (i.e. NERC-CEH on behalf of INI) and the **Implementing Agency (IA)** (i.e. UNEP). The PCU will undertake the day-to-day functions of the project, including maintaining communication between all parties in the project. Each of these groups is outlined below and further details can be found in Appendix 10.

167. The work of the project will be reviewed and informed by the **Project Partners Assembly (PPA)**, which consists of representatives of all main partners (i.e. funding partners). It represents the overarching decision-making body. In addition, the project includes a **Stakeholder and Policy Advisory Group (SPAG)** to provide advice to the project and support wider dissemination. Members of the SPAG may also be Main Partners of the project, in which case they will also be members of the PPA. Members of the SPAG otherwise have **observer** status at the PPA. External communication from the project is further supported by Component 4, which includes focus on public engagement and awareness raising. In addition to the partnership itself, the PCU and Partners may also utilize **Consultants** to conduct specific aspects of the work. Such consultants have observer status at the PPA, being represented in decisions of the PPA by their relevant hosting Main Partner.

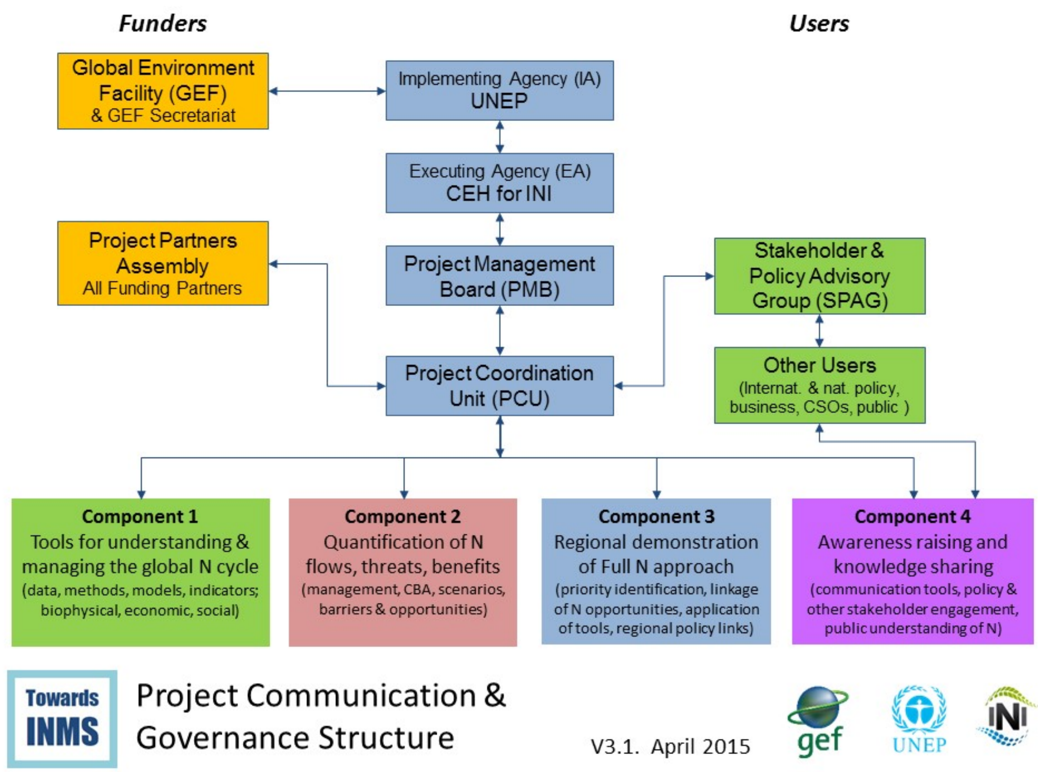

__Figure 7:__ Summary of the Towards INMS project communication and governance structure. Catalytic funding is provided by the Global Environment Facility, while all funding partners are represented in the Project Partners Assembly. UNEP is the Implementing Agency (IA), while the International Nitrogen Initiative (INI) is the Executing Agency (EA), as hosted by CEH. The Project Coordination Unit (PCU) is the team that actually manages the project coordination (based at the EA), who work closely with the Project Management Board (Component Leaders, IA and EA). The project is supported by the Stakeholder and Policy Advisory Group (SPAG), which consists of key users, which may also be project partners. Membership of the SPAG will be proposed during project Inception Phase by the EA and IA, for agreement by the Project Partners Assembly.

4.1.1 Project Management Board

168. The PMB will be established to oversee the activities of the project and to approve material (reports, outputs, etc.) for submission to the PPA, IA and to the GEF. The PMB will provide overall guidance to the project and will consist of IA, PCU (on behalf of the EA) and the Component Leaders. The PMB will meet as required for the execution of the project, making full use of electronic conferencing facilities. The PMB will receive direction (consistent with the Pro-Doc/CEO) from the PPA, supported by advice from the SPAG acting as the executive of the Towards INMS Project.

169. Note that the PMB will not be expected to deal with day-to-day administration of the project, which will be handled by the Project Co-ordinator, Project Director and PCU, under guidance from the IA. This will ensure conformity with UNEP's and GEF's requirements.

4.1.2 Project Co-ordination Unit (PCU)

170. The Project Co-ordination Unit (PCU) will be responsible for day-to-day project management and execution and will work closely with the project partners to ensure the objectives of this project are achieved. They will be responsible for providing the PPA, PMB, IA and the GEF with all management information and the required outputs from this project. The PCU will be responsible for the organization of the Inception Meeting and subsequent meetings of the Project Partners Assembly, and provide secretariat facilities for PMB, PPA and SPAG.

171. The PCU will consist of a Project Director (25% Full Time Equivalent, FTE), Project Co-ordinator (100% FTE), Technical support specialist (50% FTE), Project Management and Communications support will also be provided (up to 100% FTE, depending on staffing needs and availability) and financial support staff (25%). Terms of reference for these roles can be found in Appendix 11.

4.1.3 Project Partners

172. Two partner types are defined for the 'Towards INMS' project, as follows:

Main Partners: Organizations who have provided co-financing through cash and in-kind contributions to the project. Main Partners may also take on 'Co-ordinating' and/or 'Lead' roles. Co-ordinating Partners are those within the Project Management Board (such as Component Leaders) and Lead Partners are responsible for the delivery of either an Activity or Task. As a contributor to project co-financing, each Main Partner is a full member of the PPA.

Associate Partners: Organisations who have not provided co-financing, but who have otherwise committed to contribute to or otherwise support the project.

173. The Partners are the organizations contributing to 'Towards INMS'. Each organization will support the work through one or more of its staff, one of whom will be appointed by the Partner to be their Lead Representative for 'Towards INMS' at the PPA (Lead Representatives of Main Partners would therefore be voting members of the PPA).

174. Following the inception meeting the IA and EA may agree to propose additional Main Partners or Associate Partners to the project, which will require approval of the PPA before acceptance of a new partner is confirmed.

4.1.4 Project Partners Assembly

175. 'Towards INMS' has around 80 Main Partners contributing funding resources to the project. Their involvement is critical and essential to the overall delivery of the project. Each Main Partner will be directly represented as part of the Project Partners Assembly (PPA), which will meet annually. As the aggregate of all funding partners, the PPA is the overarching decision making body of 'Towards INMS'. Associate Partners (i.e. non-funding partners) contribute to the PPA as non-voting members. The PPA will support the execution of the project through the PMB and the PCU, who will report to the PPA annually. Members of the SPAG who are not Partners of INMS and other groups or individuals with an interest in INMS join the PPA as observers. As far as possible the PPA will take decisions by consensus.

4.1.5 Stakeholder and Policy Advisory Group (SPAG)

176. A Stakeholder and Policy Advisory Group (SPAG) will be established during the INMS Inception Phase and will meet on an ad hoc basis. A proposal for membership will be made by the PMB for adoption or amendment by the PPA. The group will advise the PMB on scientific, policy and other stakeholder issues as needed to support development of options for an International Nitrogen Management System. The SPAG will be composed of differing expertise as the needs of the project evolve and may include Partners as well as other bodies and individual experts.

4.2 Component Level & Regional Demonstrations, Decision Making and Planning

4.2.1 Decision Making & Planning in Components 1, 2 & 4

177. As described above, project level communication and governance of the work of the Components will be directed by the PMB. Within each Component are a number of Activities (each delivering on one 'Output') and within these, several Tasks (each delivering on a 'Task Output').

178. To ensure effective delivery of the 'Outputs' and 'Outcomes' of the project, each Component, Activity and Task is guided by a 'Leader' (in most cases two, allowing for flexibility and greater global representation). 'Terms of Reference' for each of these roles is included in Appendix 11. Component Leaders will be responsible for reporting back to the PCU and PMB on their progress and any issues which need to be addressed, including budget or Work Plan adjustments. Each of the Component Leaders will work with the Activity Leaders and Task Leaders.

179. Proposals individuals to act as Component Leaders, Activity Leaders and Task Leaders have been made by the EA as shown in Appendices 8 and 15-18. The proposals have been made considering i) relevant expertise, ii) institutional context, including Execution of the project through INI, iii) global and regional representativeness, iv) gender representativeness[52], v) contribution to preparing the 'Towards INMS' PPG phase and documentation. The EA will confirm nomination of Component Leaders, Activity Leaders and Task Leaders for approval or amendment by the PPA during the Project Inception Phase.

4.2.2 Decision Making & Planning in Component 3 & the Regional Demonstrations

180. To effectively execute the work planned in Component 3, it is necessary that communication flows between each of the regional demonstrations in Activity 3.1 and the remaining activities (A3.2-3.4). Therefore, it is planned to have a **'Component 3 Management Group' (C3MG)** which consists of the Component 3 Leaders, Activity leaders and representation from each of the regional demonstrations. Each of the Demonstrations will also form a '**Demonstration Management Group' (DMG)**, consisting for example of the Regional Co-ordinator(s), Project Officer(s), Task Leaders and additional experts as required.

[52] Gender is also addressed at Section B2 of the request for GEF CEO endorsement.

Section 5: Stakeholder participation

181. The following table summarizes the project partnership and current extent of stakeholder involvement. In some cases partners have found it procedurally difficult to assign a quantitative financial value to their contribution. In these cases, the organizations are listed with an unspecified value to their contribution. Where the organization has provided a specific letter of support, they are listed as Associate Partners (AP) rather than Main Partners (MP).

Table 7: *Summary of Stakeholder Engagement in 'Towards INMS'.*

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
			Partners primarily with global project focus	
C1	GEF Agency	Policy Support	United Nations Environment Programme (UNEP)	**Implementing Agency** for the project, ensuring coordination with GPA and liaison with other international frameworks. Input through secretariat for the GPNM.
C2	Non-ministry government body	Science & Policy Support	Natural Environment Research Council (NERC), Centre for Ecology & Hydrology (CEH), UK, as host of the International Nitrogen Initiative (INI)	**Executing Agency** for the project, providing Project Coordination Unit, project direction and coordination including financial management. Chair of the International Nitrogen Initiative. Co-chair and Secretariat of the Task Force on Reactive Nitrogen. Co-financing supplied through a wide range of UK and EU funded sources, including National Capability.
C3	Other	Science & Policy Support	University of Edinburgh (UED), UK, (with support to INI secretariat)	Studying many experimental and theoretical aspects of land-surface processes related to N cycling and management. Involved in numerous national and international N research collaborations, including GANE, NitroEurope, ECLAIRE, GREENHOUSE, TFRN and, most recently, the INMS pump-priming project. The lead contributing scientist directs Edinburgh's Global Environment & Society Academy, tasked with developing interdisciplinary solutions to the global challenges of food, water, energy and climate security, with projects concerning the interactions of N with greenhouse gas fluxes and nitrogen pollution swapping. Contributed to the European Nitrogen Assessment, the IPCC's Fifth Assessment Report (WGI). Science advice on nitrogen provided to Westminster and Holyrood Parliaments, and public engagement ('Nitrogen and Climate Change', 2015, Palgrave Macmillan).
D1	Other Multilateral Agency (ies)	Policy Support	Secretariat to the Convention on Biological Diversity (CBD), Canada	Secretariat Liaison with the Convention on Biological Diversity, especially in relation to mainstreaming the nitrogen challenge within CBD, as part of the Aichi indicator process (considering the N indicator in partnership with INI).
D2	Other Multilateral Agency (ies)	Policy Support	United Nations Economic Commission for Europe (UNECE)	Link to activities under the UNECE Conventions on Long-range Transboundary Air Pollution (Air Convention) and the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention). Contribution to INMS through ongoing and future activities on transboundary water cooperation in Eastern Europe (including Dniester river basin) under the Water Convention and through the Task Force on Reactive Nitrogen under the Air Convention. The platform of the Working Group on Strategies and Review under the Air Convention can be used in disseminating the results of INMS and involving governmental officials in target countries.

[53] Project Partners are here distinguished as: Coordinating Partners (C1..C3), Delivery and Research Partners (D1..D42), Business Sector Partners (B1..B9), Civil Society Partners (S1..S3), Regional Case Study Partners (R1R34).

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
D3	Other Multilateral Agency (ies)	Policy Support	Organisation for Economic Co-operation and Development (OECD), Paris	Policy analysis on the nitrogen cycle in relation to country programmes and national case studies. Development of environmental indicators and investigation of nitrogen indicator as broad measure of environmental performance (linking air, land, water, climate, biodiversity etc). Integration of existing agricultural nitrogen balances indicator into full regional nitrogen budgeting approaches. The platforms provided by the Environmental Policy Committee (EPOC) and the Working Party on Water Biodiversity and Ecosystems (WPWBE) can be used in disseminating INMS results and involving government officials in target countries.
D4	Other Multilateral Agency (ies)	Science & Practices	Food and Agriculture Organization of United Nations (Livestock Information, Sector Analysis and Policy Branch (AGAL) , Animal Production and Health Division, (FAO-AGAL), Rome	Provides livestock sector analysis with a particular focus on resource use, environment and poverty reduction. It also provides policy support and guidance to countries and stakeholders in the livestock sector, and facilitates policy dialogue among stakeholders. AGAL will contribute to INMS through: a) Knowledge transmission on global database on agricultural commodities and inputs (GLEAM); b) Assessments of nitrogen use efficiency for livestock supply chains by region, commodity and farming systems at different scales; c) Development of mitigation strategies to reduce the environmental impact from livestock sector; d) Benchmark and monitoring of improvement options in livestock sector; d) Facilitation of policy dialogue and harmonization of metrics through international multi-stakeholders initiatives: Global Agenda for Sustainable Livestock and Livestock Environmental Assessment and Performance (LEAP) Partnership.
D5	Other Multilateral Agency (ies)	Science & Policy Support	World Meteorological Organization (WMO), Global Atmospheric Watch, Geneva	Secretariat Liaison with the Global Atmospheric Watch efforts on quantifying atmospheric concentrations and deposition of reactive nitrogen compounds, for verification of models, including key gap analysis in developing regions.
D6	Other Multilateral Agency (ies)	Science & Policy Support	International Institute for Applied Systems Analysis (IIASA)	Research contribution in the development of nitrogen integrated assessment modeling linking air pollution, human health, ecosystems, greenhouse gases and water pollution, building on IIASA's GAINS model, which elucidates important aspects of the nitrogen cycle in to with mitigation and mitigation costs. Development of regional nitrogen budget approaches and efficiency indicators. Contribution to European scale coordination (Director INI European Centre) and Chair of TFRN Expert Panel on Nitrogen Budgets (EPNB).
D7	Other Multilateral Agency (ies)	Science & Policy Support	European Commission Joint Research Centre (EC-JRC), Italy	Contribution to the development of regional and global nitrogen flow modeling, including development of indicators, regional synthesis, and options including integration of technical measures and structural change (societal choice and consumption related). The mission JRC is to provide EU policies with independent scientific support throughout the whole policy cycle. In particular, the Institute for Environment and Sustainability (IES) supports to EU policies for the protection of the environment, and the more efficient and sustainable management of natural resources.
D8	Other Multilateral Agency (ies)	Science & Practices	International Maize and Wheat Improvement Center (CIMMYT) (part of CGIAR)	Leads research on sustainable intensification in wheat and maize-based systems in South Asia, Sub-Saharan Africa and Latin America and has considerable expertise in N management. Access to facilities to measure N balance in crops and provide field facilities for demonstration, evaluation of management practices on N use efficiencies of crops. Through work on climate smart villages, CIMMYT is evaluating a range of technologies and practice portfolios, with strong community-led involvement, local organizations and strong public sector buy in. The CIMMYT impact pathway is to generate evidence on the costs and benefits of emerging practices and technologies in terms of productivity and climate change adaptation and mitigation. Outputs from 'Towards INMS' could be scaled up through CSV models in South Asia and through CIMMYT innovation hubs of MasAgro Take it to the Farmer (TTF) project in Mexico and the Cereal Systems Initiative for South Asia (CSISA).

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
D9	Non-ministry government body	Science & Policy Support	PBL Netherlands Environmental Assessment Agency, The Netherlands	Experience in global and regional assessments and scenario studies of production of consumption of energy and food on environmental emissions to air and water and impacts and air and water quality, the GHG balance and biodiversity. Assessments and scenario studies include aspects of governance and consumers choice. For this purpose PBL has developed the IMAGE and GLOBIO models and cooperated with various research groups around the globe on international IPCC, OECD and UNEP environmental assessments. Will provide analysis of nitrogen management options in relation to food choice and technical measures coupling water, air, climate, biodiversity issues in relation to quantitative assessment and building of green economy links. Builds leadership of N cost-benefit analysis and lead of the Expert Panel on Nitrogen and Food.
D10	Non-ministry government body	Science & Policy Support	National Institute for Public Health and the Environment (RIVM), The Netherlands	Monitoring and modelling N-flows in the environment. Recently, the policy program Integrated Approach to Nitrogen in which all N-sources to air are considered has been adopted and RIVM is in the lead to monitor this program for the Netherlands. RIVM is extending the scope of its work to other N-flows and other environmental and public health impacts. Contribute to INMS with experience in measuring and modelling N-flows and by making these flows quantitative and manageable for use in policy support (esp. Activities 1.3, 1.5 and 2.1)
D11	Non-ministry government body	Science & Policy Support	Italian National Agency for New Technologies, Energy and sustainable economic development (ENEA), Italy	ENEA conducts research and innovation activities, especially including energy efficiency and renewable energy sources, technological innovation, agro-food, health, and the environment. Examination of regional nitrogen flows in relation to societal choice options with specific attention to regional food access and food choice options, building on the work of the Expert Panel on Nitrogen and Food (EPNF).
D12	Non-ministry government body	Science & Practices	Institut Nationale Recherche Agronomique (INRA), France	INRA is the biggest Institute for agronomic research in Europe. Reactive nitrogen is an issue which is mostly related to agriculture by the way of crop fertilisation and livestock farming (esp. manure management). INRA could provide INMS with (i) databases on N use, on N, C and water fluxes, (ii) crop models including C and N cycling, economic models, actor models (iii) decision support tools for N fertilization and estimating N losses and (iv) long term observation sites. INRA has strong partnerships with many agriculture stakeholders and French decision makers. The involvement will seek to distill and synthesis key experiences from French agriculture allowing technology sharing with regional studies and analysis of barriers to change.
D13	Ministerial governmental body	Science & Policy Support, Regulation	United States Environmental Protection Agency (US EPA), United States	US EPA is the national agency responsible for many of the regulatory management of air and water quality, and in turn the nitrogen cycle in the US. EPA has a program office side, whose staff are responsible for policy decisions and implementation and have played key roles in the development of global environmental policies and funding mechanisms such as the GEF. EPA also has a research side that informs policies and policy-makers. Many EPA researchers measure and model the amount of nitrogen moving through air, land and water. EPA researchers also study the impacts of excess nitrogen on the human health, the environment and the economy. Much of EPA's nitrogen research is US in scope even though EPA is on the Governing Committee of various intergovernmental programs, including UNEP and the OECD programs on nutrient pollution. In making progress toward sustainable decisions, it would be best for EPA and the INMS partners to learn from and exchange research and inform policy-makers toward global sustainability.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
D14	Non-ministry government body	Science & Policy Support	Federal Environment Agency of Germany (UBA), Germany	UBA is a policy advising institution gathering data concerning the state of the environment, investigating the relevant interrelationships, making projections and providing federal bodies such as the Ministry of the Environment with policy advice. UBA also provides the general public with information on the environment. One important field of interest is the reactive nitrogen (N_r) issue as Germany is obliged to commit to various N_r associated environmental quality standards. Several projects are set up to quantify N_r fluxes, calculate N_r budgets and balances and support the German integrated N_r policy initiative and several actions on international cooperation.
D15	Non-ministry government body	Science & Policy Support	Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME), France	ADEME provides expertise and advisory services to businesses, local authorities and communities, government bodies and the public at large, to enable them to establish and consolidate their environmental action. As part of this work, the agency finances projects, from research to implementation, in its areas of action. ADEME is then greatly interested in the development of a science-policy support process, to enable the more effective management of nitrogen whilst minimizing the environmental impact.
D16	Non-ministry government body	Science	Consiglio Nazionale delle Ricerche - Istituto per la Protezione Sostenibile delle Piante (CNR-IPSP)	Experience in the studies of plant responses to abiotic stress factors, with an aim of translating response mechanisms and adaptation processes into risk assessment and protection methodologies. CNR-IPSP coordinated and participated in many international projects (including ECLAIRE), and is experienced in communication and contacts with stakeholders. Contribution to INMS includes provision of data for 1. The parameterization of plant responses to N deposition, water stress and ozone exposure, for plant species representative of the major plant functional types in under-investigated areas of the globe (South-America and Asia) 2. nitrogen-ozone-VOC interactions in a demonstration forest area in Mediterranean climate.
D17	Non-ministry government body	Science	Norwegian Meteorological Institute, Oslo, Norway (MET Norway)	The Norwegian Meteorological Institute hosts the western air pollution modelling centre of the European Monitoring and Evaluation Programme (EMEP MSC-W). The EMEP MSC-W model has been developed over more than 30 years for the calculation of sulphur and nitrogen deposition, as well as for tropospheric ozone and particulate matter (PM). Although traditionally used at the European scale with resolutions of ca. 50km, the current model has been applied both globally (0.5 degrees resolution) and for near-urban scale (1-2 km) within the EMEP4UK project. MET Norway has a long history in authoritative modelling of the long-range transport of pollution, especially for the UNECE LRTAP Convention. Met.no will engage to develop N-modelling capabilities, including atmosphere-biosphere simulations of future N-scenarios in different economic and climate change scenarios.
D18	Non-ministry government body	Science & Practices	Victorian Department of Economic Development, Jobs, Transport and Resources (DEDJTR), Australia	Victoria is Australia's largest food and fibre exporting state and DEDJTR is Australia's leading agriculture research and development organization. Better managing N to meet production and environmental goals is a high priority. DEDJTR highly values international collaboration and recognizes the benefits of international harmonization of methods, practices and tools targeting N use efficiency. To that end, DEDJTR is proposing to work in close collaboration with a number of international research groups from New Zealand, USA and Europe on improvement of farm scale management of the nitrogen cycle,, with an emphasis on using an farm level N budgeting approaches. This will support the development of on-farm and catchment indicators and methods to quantify nitrogen utilization, identify sources of nitrogen losses, quantify various pathway losses and develop strategies to minimize environmental impacts.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
D19	Others	Science, Practice & Policy Support	Alterra Wageningen University and Research Centre (ALTERRA)	INMS interests relate to: (i) nutrient cycling and management in the food production – consumption chain and (ii) impacts of nutrient use on soil and water quality, climate and biodiversity at a range of spatial and temporal scales. Active engagement with Towards INMS under the Components 1 and 2, especially in relation to: development of regional biogeochemical models in agriculture and natural systems, on the refinement of indicators and on the benchmarking of indicators in agriculture (efficiencies and surpluses). Examination of best management practices and the social and economic factors that determine success.
D20	Others	Science & Practice	Wageningen University and Research Centre, Livestock Research (WUR-LR)	Research in reducing NH_3 and other N-compounds from livestock husbandry, with focus on technical mitigation methods and management tools and optimization of nutrient management. WUR were involved in writing the UNECE Guidance document on mitigating ammonia, the UNECE Framework Code for good agricultural practices, the Agricultural Annex of the Guidance document on National Nitrogen Budgets and in the review of the BAT Reference document for intensive pig and poultry. WUR developed Feed Print, which calculates the carbon footprint of feed ingredients. We have mapped manure management over the world to understand how different regions handle manure, to be able to provide the best tool at the right place to mitigate environmental impact. We are involved in projects to enhance knowledge hubs on manure management and resource use efficiency.
D21	Others	Science & Policy Support	Energy research Centre of the Netherlands (ECN), The Netherlands	Involvement in different ongoing global activities related to the INMS objectives, as well as recent activities on a European level that directly link to the INMS activities (e.g. TFRN/EPNB, ESF-NinE/ENA). Development of simpler regional indicators of nitrogen efficiency performance and comparison with more detailed approaches, extending the analysis to improve estimates of full-chain nitrogen use efficiency.
D22	Others	Science	Vrije university and Louis Bolk Institute (VU), The Netherlands	A focus on Integrated Nitrogen Studies in the world, which is in the heart of the INMS proposal. The VU has a range of experiences in coordinating N-related projects, courses on nutrients and biogeochemical cycles, atmosphere-biosphere research and satellite observations and validation. Furthermore, through several contributions policies and solutions for N-pollution have been developed and successfully implemented. Particular interest in on nitrogen foot printing (N-PRINT), and environmental farming approaches.
D23	Others	Science & Practices	Nederlandse organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek (TNO), The Netherlands	Currently estimating and predicting NH_3 concentrations and reactive nitrogen is severely hampered by a lack of good emission timing in the chemistry-transport models (CTMs). The emission of NH_3 varies locally and inter-annually as a result of local climate (temperature) and local agricultural management. Our research in the coming years will include deriving and testing parameterization of ammonia emissions for use in our chemistry-transport model LOTOS-EUROS. A more realistic representation of the emissions will change the deposition patterns and hence may influence the most effective policies to protect nature reserves and reduce emissions. As part of this development TNO will also focus on further increasing the spatial resolution of its model to more accurately represent local emission and local depositions that can be of direct benefit to Component 1 of the 'Towards INMS' project.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
D24	Others	Science & Policy Support	Potsdam Institute for Climate Impact Research (PIK), Germany	Studying causes and effects of land-use change, including externalities such as N_r pollution. It develops and maintains two complementary global simulation models, a bio-physical dynamic global vegetation, hydrology and crop growth model LPJmL and a spatially explicit economic agricultural sector model MAgPIE. Both models can be applied jointly and separately and have a long-standing reputation in global change research. The models have been applied (MAgPIE) and are currently being further developed towards explicit treatment of N dynamics to address the full terrestrial N cycle in natural and managed ecosystems as well as the economic assessment of environmental regulation and market mechanisms. The group is involved in model intercomparison studies (AgMIP, ISI-MIP) and can connect N-specific research questions of INMS with these activities. High spatial detail in simulations and analyses allows for connecting regional studies and mechanisms with global-scale responses in a consistent analysis.
D25	Others	Science	University of Bonn (UBO), Germany	Working in plant/atmosphere exchange, identifying and investigating fundamentals of aerosol impacts on plants. Our activities, e.g. within the ECLAIRE project, have taken this forward to a point where we could show that aerosols formed from NH_3 can reduce the drought tolerance of plants, indicating a so far unknown, serious threat of NH_3 to ecosystems. Our present funding largely comes from fundamentally oriented organizations (DFG), and we are interested to make the results suitable and useful in the interdisciplinary INMS environment, e.g. for the implementation in dynamic global models.
D26	Others	Science & Practices	Leibniz Institute for Agricultural Engineering (ATB), Potsdam-Bornim, Germany	A European center of agricultural engineering research at the nexus between biological and technical systems. Research targets a knowledge-based bioeconomy. ATB is developing highly innovative and efficient technologies for the use of natural resources in agricultural production systems - from basic research to application. ATB thus contributes to the nutrition of humans and animals, to a sustainable use of biomass, and to protecting of climate and environment. Co-chair of the UNECE-TFRN Expert Panel on Mitigation of Agriculural Nitgrogen (EPMAN) and UNECE Task Force on Emissions Inventories (TFEIP) Agriculture and Nature Panel.
D27	Others	Science & Practices	Aarhus University – Bioscience (AU-Bios), Denmark	Has the main responsibility to guide the Ministry of Environment in Denmark and has as such being responsible for the nitrogen monitoring in surface waters and agricultural catchments for more than 25 years. Have several Danish and International projects that include Nitrogen assessments and modelling that can support the INMS project including our nearly 30 years of N data collected that are stored in databases
D28	Others	Science & Practices	Aarhus University - Agro (AU-Agro), Denmark	Has for many years been conducting research and providing policy support on nitrogen flows in agricultural systems. This work has included the development and use of methods to quantify nitrogen flows at field, farm and regional scales. Furthermore, we have conducted extensive experimentation at the level of the animal, manure management system and field to identify practical measures that can be taken to reduce losses of nitrogen to the environment. Recently, sustainable intensification of cropping systems to support green biorefinery and protein production has been developed. Provides policy support to the Ministry for Food, Agriculture and Fisheries for Denmark. As such, AU-Agro is familiar with dealing with the technical, regulatory and economic aspects of nitrogen management policy.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
D29	Others	Science & Practices	Aarhus University – Department of Enviromental Science (AU-Envs), Denmark	Operates the Danish air quality monitoring program, and in relation to this work Danish nitrogen budgets are established each year by comparing Danish emissions to nitrogen deposition to Danish marine and terrestrial ecosystems. Includes scenario studies of the contribution from Danish and foreign sources as well as projections on future development in nitrogen depositions. ENVS AU produce the Danish national emission inventories incl. those for atmospheric releases of nitrogen, with experience of high temporal and spatial resolution emission inventories. Experience and economic valuation of the environmental pressures from various sectors.
D30	Others	Science & Practices	Institute of Water Resources Engineering (ASU), Lithuania	Many years of experience in conducting research on nitrogen losses from agricultural areas to surface waters at different spatial scales (field and catchment). Long-term nitrogen budget calculations and the effect of various land management practices have been investigated. The offered contribution to 'Towards INMS' is skills, experiences and review. Recent research suggests that a limited response of freshwater eutrophication to decline in agriculture is related to land management practices as well as to significant inertia of the terrestrial ecosystems that control the loss of N from land to rivers. The research emphasis is therefore on improving understanding of the N cycle to reduce the negative impacts through improved N management practices and policies.
D31	Others	Science Support	Agrophysical Research Institute (ARI), Russia	Has an extensive experience in research cooperation in the subject of nitrous oxide emission from arable soils. We have partners inside the country who we are prepared to work together with in the 'Towards INMS' project. Together we will also apply for grants inside Russia to support our activities in the 'Towards INMS' project.
D32	Others	Science Support	Institute of Physicochemical and Biological Problems in Soil Science (IPBPSS), Russia	Researches of N biogeochemical cycle in natural and semi-natural ecosystems in Russia. Recent and current activities and projects of IPBPSS are relevant for INMS. Skills in modelling N cycle dynamics and assessment of N fluxes in forested lands. System of models EFIMOD, which were created in IPBPSS, has been used in many regional researches on modeling the impacts of N deposition and climate change on forest dynamics and biodiversity. IPBPSS was a partner in the ECLARE project participating in the work on developing dynamic soil vegetation models. Also involved in the activities of the LRTAP Convention and responsible for calculating and mapping critical loads of N for the European Russia area.
D33	Others	Science & Practices	Instituto Superior de Agronomia (School of Agronomy) of the University of Lisbon (ISA), Portugal	Interest in improving agronomic practices that reduce nitrogen losses to water and air and in the synthesis and translation of evidence to support practice improvement and the policy development. Will contribute to the development of optimized approaches for N management (Activity 2.3) and support the European regional demonstrations. Co-chair of the UNECE Task Force on Reactive Nitrogen.
D34	Others	Science & Practices	Ataturk Horticultural Central Research Institute (ABKAE), Turkey	A public research institute working under the Ministry of Food, Agriculture and Livestock. ABKAE took part as a "Central Research Organization" in the priorities, policies, program and budget within the framework of research activities in the country on the basis of horticulture. Projects prepared under the nation-wide programs are carried out by individual scientists or teams from ABKAE or collaboration with other institutes and/or related faculties of the Universities. Within the framework of its duties, ABKAE prepares and joins research projects on evaluation-selection and breeding of high yielding, well adapted, disease resistant horticultural cultivars; agrotechnology (fertilization, irrigation, protection, physiology etc.), storage, processing and marketing. ABKAE organizes courses, seminars, conferences, training programs and workshops regularly for farmers, agricultural engineers, agricultural technicians, economists and home growers.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
D35	Others	Science & Practices	Fundacao da Faculdade de Ciencias da Universidade de Lisboa, FP (FFCUL), Portugal	Contribution to INMS will be provided mainly from an international project (NitroPortugal), and will be focused on the organization of outgoing short and medium term staff exchanges and of incoming expert visits, collection of data from databases and grey literature, and on the organization of training and outreach activities. It generally aims at improving the knowledge of N-related issue on water, air and soil quality, greenhouse gas balance and impacts on ecosystem and biodiversity, to build the basis for a Portuguese Nitrogen Assessment.
D36	Others	Policy Support & Practices	Stockholm Environment Institute at York / York University (SEI/UoY), UK (link partner to the Climate and Clean Air Coalition, CCAC)	The 'Nitrogen Cascade' links closely with SEI's interest in air pollution and climate change and the water-land-energy nexus and developing integrated approaches examining trade-offs and synergies to inform decision making. Expertise relevant to INMS covers: coordinating and participating in regional and global integrated assessments for UNEP on Short-Lived Climate Pollutants (SLCPs); the Global Atmospheric Pollution Forum (GAP Forum) platform for global co-operation on air pollution issues; capacity building projects with the Climate and Clean Air Coalition (CCAC), the Consultative Group for International Agricultural Research (CGIAR) and World Bank assessing air quality, water and fertilizer issues in local/national agriculture; development of global trade and supply chain methodologies assessing links between consumption of commodities and impacts due to low NUE; impact assessment and modelling of how pollutants and other stresses combine.
D37	Others	Science & Practices	University of East Anglia (UEA), UK (link partner to the IOC UNESCO GESAMP Working Group 38)	The GESAMP working group has been studying the impact of air-sea exchange for many years and has recently focused particularly on the impact of atmospheric nitrogen deposition.
D38	Others	Science, Practice & Policy Support	North American Nitrogen Centre of INI (Including: US Environmental Protection Agency, US Department of Agriculture, US Geological Survey, Agriculture and Agri-Food Canada, University of Virginia,) (NANC)	NANC fosters collaboration of governmental and non-governmental organizations, universities and private individuals who are collectively trying to develop successful voluntary or regulatory ways of reducing N_r losses from agriculture and the built environment. Environmental endpoints, or critical loads, for terrestrial and aquatic ecosystems are actively researched. Workshops and synthesis activities drawing together continental-wide evaluations of both the state of knowledge and the socio-economic impediments to increasing crop NUE are supported and results are presented to stakeholders and peers at professional society venues.
D39	Others	Science & Policy Support	New York University (NYU), USA	The Department of Environmental Studies and the Guarini Center for Energy, Environmental and Land Use Law address interdisciplinary and policy-relevant environmental research. The Guarini Center has developed a 'building blocks' approach to global climate governance – using smaller, more decentralized forms of cooperation for climate protection – which is a valuable framework for investigating the various legal pathways available to manage global N pollution. The array of environmental and health impacts that can be traced back to N pollution creates several opportunities for generating climate co-benefits by engaging organizations with non-climate missions such as global health and agricultural development. NYU will play an active role in INMS Activities 4.3-4.4, particularly Task 4.4.2 (policy homes and financing models). The interdisciplinary array of faculty members doing environmental research – from lawyers and economists, to biologists and anthropologists – as well as its location in the heart of New York City make it a perfect base for exploring the global governance challenges related to N pollution.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
D40	Others	Science & Practices	World Resources Institute, Water Quality Team (WRI), USA	Has been working on eliminating eutrophication for more than a decade, including the extent of eutrophication worldwide, the drivers and sources, and policy mechanisms for addressing eutrophication. WRI has an interactive global map of over 700 eutrophic and hypoxic coastal zones. WRI is an expert on flexible, market-based solutions to cost-effectively achieve water quality goals, such as trading and targeting. Policy analysis, program evaluation, and analyses on barriers to change. Developed a global database of nutrient-reducing practices and nutrient-reducing programs and policies for the GEF GNC project. With offices in India, China, Brazil, Belgium, and Indonesia, WRI has an international presence and many local partners in developing countries.
D41	Others	Science & Practices	University of Missouri (MU), USA	Better managing nitrogen to meet production and environmental goals is a high priority for University of Missouri. University of Missouri highly values international collaboration and recognizes the benefits of international harmonization of methods, practices and tools targeting N use efficiency. The contribution will focus on the development of on-farm and catchment indicators and methods to quantify nitrogen utilization, identify sources of nitrogen losses, quantify various pathway losses and develop strategies to minimize associated environmental impacts.
D42	Others	Science & Practices	AgResearch Ltd (AgResearch), New Zealand	AgResearch is New Zealand's leading pastoral agriculture research and development organization. Better managing nitrogen to meet production and environmental goals is a high priority for AgResearch. AgResearch highly values international collaboration and recognizes the benefits of international harmonization of methods, practices and tools targeting N use efficiency. AgResarch will contribute to the development of on-farm and catchment indicators and methods to quantify N utilization, identify sources of N losses, quantify losses and develop strategies to minimize the resulting environmental impacts.
B1	Private Sector / Business	Policy & Practices	Fertilizers Europe (Fertilizers Europe), Belgium	In 2014 Fertilizers Europe established the EU Nitrogen Expert Panel. This panel is an independent group of leading scientists, industry representatives, practitioners, and governmental policy officers (total of 15-20 persons). The general objective of the Expert Panel is to contribute to improving NUE in food systems in Europe, through (i) communicating a vision and strategies on how to improve NUE in food systems in Europe; (ii) generating new ideas, and recommending effective proposals and solutions; and by (iii) acting as referee in controversial issues, and by communicating as authority. The first mandate of the EU N Expert Panel is to prepare a well-elaborated proposal for 'nitrogen use efficiency' in food systems in Europe, to be used as indicator by policy and practice. More mandates contributing to better and more sustainable use of nitrogen will be defined with time to come.
B2	Private Sector / Business	Science & Practices	Yara International ASA, Research Centre Hanninghof (Yara), Germany.	Yara converts energy, natural minerals and nitrogen from the air into essential products for farmers and industrial customers. The main application is fertilizers, while industrial uses and environmental solutions are also important growth segments. The backbone of the company's operations is large-scale ammonia and fertilizer production in many regions of the world. We ensure reliable supplies of mineral fertilizer and related industrial products to customers worldwide. Yara is one of the world's largest producers of ammonia, nitrate and complex fertilizer. At its centre for plant nutrition, Yara conducts research to develop improved plant nutrition management strategies for important agricultural crops.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
B3	Private Sector / Business	Science & practices	BASF SE, Division of Plant Protection, Germany	Developing novel solutions to reduce reactive nitrogen losses (mainly ammonia, nitrous oxide and nitrate) and working on establishing optimal conditions to get the best efficiency out of the N fertilizer applied to the field in agricultural systems. BASF runs global field trials on all five continents of which it can provide results and data. In addition BASF is willing to share compounds for testing in other locations (subject to local restrictions). Particular interest in developing novel nitrogen enzyme inhibitors to improve nitrogen use efficiency and decreases overall losses from reactive nitrogen pools.
B4	Private Sector / Business	Science & Practices	SKW Stickstoffwerke Piesteritz GmbH (SKWP), Germany	A producer breaking new grounds of N fertiliser use by developing new innovative products including recommendations on best usage and practices with an emphasis on improving N use efficiency. We have an own research department with scientists in the area of chemistry, analytics and agriculture as well as an agricultural experimental station. During the last years we have generated fundamental results concerning NH_3 and N_2O emissions after application of N fertilisers under practical related conditions in typical German agricultural areas. We are the sole institution holding NH_3 emission results over a three year typical crop rotation in Germany. In this study we identified and quantified options to reduce gaseous N losses significantly. In addition, we have experiences in efficient and loss reduced use of organic fertilisers like slurry or biogas digestate. We are open to integrate concertedly developed methods and measure in our existing research program and demonstrate best available practice in N fertiliser use.
B5	Private Sector / Business	Science, Policy & Practices	PigCHAMP Pro Europa (PCH), Spain	PigCHAMP Pro Europa S.L. is company located in Segovia, Spain. Its activity is aimed at consulting livestock, mainly pigs. Since 2000, technical advisor of Tragsatec, the means of the Ministry of Agriculture, Livestock and Environment to implement the Industrial Emissions Directive and in the preparation of the Technical Document on Best Available Techniques. Members of the Technical Working Group of the European IPPC-Bureau for IRPP-BREF. Over 10 years in the development of trials for the evaluation of techniques and products to reduce emissions of pollutants, in farm and field. A member of TFRN and contributor to the UNECE ammonia guidance document.
B6	Private Sector / Business	Policy Interest & Practices	International Fertilizer Manufacturers Association (IFA), Paris, France	IFA is the only association representing the global fertilizer industry. IFA has the best available global database on N fertilizer capacity, production, trade and consumption for the main fertilizer products and raw materials. IFA encourages adoption of best available technologies in fertilizer production in order to improve energy use efficiency and reduce GHG emissions. It also supports development and adoption of fertilizer best management practices in order to enhance the use efficiency and effectiveness of fertilizers, and promotes smallholders' access to fertilizers in Africa and other areas with underuse. IFA has more than 500 members throughout the world. As such it can help reaching out to the global fertilizer industry to stimulate their engagement in INMS activities where needed (e.g. in regional demonstrations), and to disseminate the main outcomes of INMS.
B7	Private Sector / Business	Science & policy interest	International Plant Nutrition Institute (IPNI), United States.	Global research partner of the fertilizer industry. Sharing of expertise in “4R Nutrient Stewardship” (right source at the tight rate, right time, and right place) that leads to enhanced crop production and crop quality, soil fertility improvement and sustainability, and attractive economic returns for farmers and allied industries, while also being socially acceptable and environmentally responsible.
B8	Private Sector / Business	Policy & Practices	CEMA aisbl – European Agricultural Machinery	Interest in the development of low emission practices, especially in regard of manure spreading methods, including liaison with other regional agricultural machinery organizations.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
S1	Civil Society Organisation	Policy and Dissemination	Non-Governmental Organisation ' New Energy' (New Energy), Ukraine	During last two years NGO "New Energy" has implemented the following projects: Social communication - new opportunities for active youth (2014 - funded by the German Foundation Nadegda); Elaboration and dissemination of recommendations on basin management of surface water resources used for drinking water supply in Kharkiv Oblast (2015 - under the Program "Ukrainian Unconventional Gas Institute" and administrated by the British Council in Ukraine). New Energy is currently engaged with the following projects: Integrated Hotspots Management and Saving the Living Black Sea Ecosystem (Black Sea Crossborder Cooperation programme); Stormwater quality: Implications for reduced impact on receiving waters and climate change adaptation. They recently contributed to Network for Environmental Assessment and Remediation in Aquatic Systems. Wastes and Wastewaters (2010-2012 – SCOPES programme) and EnviroGRIDS Project "Building Capacity for a Black Sea Catchment Observation and Assessment System supporting Sustainable Development" (EU programme).
S2	Civil Society Organisation	Policy & Dissemination	World Wide Fund for Nature conservation (WWF)	Stakeholder interested in dissemination of information on the nitrogen challenge, the benefits of nitrogen to modern society in relation to the regional and global challenges for nature.
S3	Civil Society Organisation	Policy & Dissemination	Planetary Boundary Initiative (PBI)	The PBI is a small NGO committed to governance that safeguards humanity against transgressing Earth's biophysical limits. Activities involve legal research, policy analysis, advocacy and the convening of multi-disciplinary experts and NGOs, to reach consensus on new governance options and this includes nitrogen as a key priority area. Research would review options for global, regional and local scales in response to planetary boundary science. We would develop research and explore findings with multi-sector NGOs, supported by our advisory group members.
			Partners primarily with regional demonstration focus in the project	
			CASE 1: Developing regions with excess reactive nitrogen	
R1	Others	Science and Practices	Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China (ISSCAS), China	Pioneer in agricultural nitrogen research in China, focusing on the agronomic effect and environmental impact of nitrogen fertilizer. Has a number of researchers involved in nitrogen research, ranging from field study to regional evaluation. ISSCAS has led several national wide nitrogen related projects, and has hosted the 3rd International Nitrogen Conference. It is now leading a Nitrogen Working Group under China Soil Science Society. The group is made up of experts of different science background, inducing soils soil science, atmospheric science, aquatic science, etc.
R2		Science & Practices	National Institute for Agro-Environmental Sciences (NIAES), Japan	NIAES is a research institute focusing on environmental issues related to agriculture including nitrogen challenges such as cropland emissions of nitrous oxide, nitrate leaching to groundwater, and local-to-regional evaluations of nitrogen cycle. NIAES will thereby facilitate the involvement of Japanese scientists into the East Asian Regional Demonstration in close collaboration with the International Nitrogen Initiative–East Asia. Furthermore, NIAES is pursuing the Monsoon Asia Agro-Environmental Research Consortium (MARCO), which aims to provide international symposia and help to train the people who will carry on activities under the consortium. It is expected that MARCO also contributes to the case study.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
R3	Others	Science, Practice & Policies Support	China Agricultural University, Beijing - Crop and Environment (CAU - Crop)	Systematic research work on nutrient cycling and nutrient resource management in major Chinese intensively managed cropping systems. Meanwhile, CAU has also done much work on how to transfer nutrient management techniques to local farmers in order to improve their crop production and nutrient use efficiency while decreasing its nutrient losses to the environment. As a partner to INMS, CAU – Crop & Environment will provide experiences in producing more grain with moderate nutrient input and lower environmental costs.
R4	Others	Science & Practice	China Agricultural University, Beijing - Soil Science (CAU - Soil), China	A strong background working on N cycling and environmental impacts, which also covered by several ongoing projects. CAU-Soil is greatly interested in the development of the 'Towards INMS' partnership, and will contribute to several activities in components of quantification of N flows ,threats & benefits, and regional demonstration of the full N approach etc, to enable the more effective management of N whilst minimizing the environmental impact
R5	Others	Science Support	Beijing Forestry University (BFU), China	Focus on natural ecosystem (forests and wetlands) protection and management in China. It was firstly founded by both Ministry of Education and Bureau of Forestry of the national government. The group is addressing in developing nutrient measurements and models for watershed/ catchment level managements, which are not only referred to the nutrient enriched agricultural systems, but also natural ecosystems as nutrient sinks. Proposes to contribute to INMS Activities 1.1 and 2.1 and share results from its ongoing programme of work.
R6	Others	Science & Practices	Zhejiang University (ZJU), China	Currently, research in ZJU mainly focuses on the N biogeochemical cycle in coupled human and natural systems (CHANS). We have built the nitrogen cycling model in the CHANS to include both natural and anthropogenic factors that drive the global and regional nitrogen cycles. Based on the CHANS model, we have analyzed the entire nitrogen cycling in China for 14 subsystems, and closed the N budget and their future trends in China. ZJU will contribute to INMS on the industrial N cycling on regional and global scales, source appointment of atmospheric and hydrospheric nitrogen pollutions, nitrogen footprint by CHANS mass balance approach and cost-benefit analysis.
R7	Others	Science & Practices	Center for Agricultural Resources Research, Institute of Genetic and Developmental Biology, Chinese Academy of Science (CARR), China	The Chinese Academy of Sciences, Centre for Agricultural Resources Research (CARR), Institute of Genetic and Developmental Biology will provide underpinning support for the science of Towards INMS to maximize the benefit of nitrogen for agriculture while minimizing the environmental threats. Specifically, CARR will contribute to Components 1 and 2 in developing nitrogen system indicators (Activity 1.1) and in the development of future nitrogen storylines and scenarios (Activity 2.4).
R8	Others	Science & Practices	Field Science Center for Northern Biosphere, Hokkaido University (FSCNB-HU), Japan	Conducts comprehensive research primarily on the northern biosphere on the conservation processes and mechanisms that impact biodiversity and ecosystem processes, the sustainable use of natural resources and ecosystem, long-term monitoring of various ecosystems and environments. The research topics include ecology, biology, biogeochemistry, environmental science, agriculture, forestry, fishery and others. The ecosystem functions section covers biogeochemical studies including nitrogen which is highly relevant for the 'Towards INMS' project. FSCNB-HU has various international partnerships with oversea universities and research institutes for collaborative program for research and education, including leading the nitrogen action of the International Long-Term Ecosystem Research (ILTER) network. The research facility, project outcomes, database and other research resources are available for the 'Towards INMS' project.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
R9	Others	Science & Practices	Research Faculty of Agriculture, Hokkaido University (Ag-HU), Japan	Conducts research primarily on the northern biosphere on the sustainable use of natural resources and ecosystem, long-term monitoring of various ecosystems and environments, in relation to agricultural activity. The research topics include agricultural science, ecology, biology, biogeochemistry, environmental science, forestry, fishery and others. One of the research laboratories, the environmental biogeochemistry lab covers agricultural studies including nitrogen which is highly relevant for the INMS project. Ag-HU has various international partnerships with oversea universities and research institutes for collaborative program for research and education. The research facility, project outcomes, database and other research resources are available for the INMS project.
R10	Others	Science & Practices	National Institute for Environmental Studies (NIES), Japan	NIES is funded by the Ministry of Environment, Japan, covering a wide range of environmental researches such as climate change, pollution, biodiversity, material cycling, human health, and sustainability. It comprises eight research centers and one regional branch, some of which are working on regional and global nitrogen issues. The Center for Global Environmental Research is measuring atmospheric composition including several nitrogenous gases and developing a global biogeochemical cycling model. The Center for Regional Environmental Research is observing watershed-scale nitrogen cycling from atmospheric deposition to underground leaching. NIES has internal activities for these center's missions and several funded projects for integrated assessment on climatic change.
R11	Others	Science & Practices	Kyoto University (KU), Japan	Interested in the effective utilization of an indicator, Total Material Requirement, TMR. The TMR provides a measure of the physical inputs in mass required to produce a material from a given resource using a given process, including upstream inputs, in terms of primary materials including so-called hidden flow such as tailings, gangue, and waste rock, etc. Recently KU redefined two types of TMR. The first type is the TMR to obtain a material from a natural ore (natural ore TMR; NO-TMR), which is in keeping with the original definition of TMR. The other type is the TMR to recycle the material from an urban ore defined as end-of-life products or waste (urban ore TMR; UO-TMR). Recently KU has estimated TMRs for more than 400 products like not only metallic materials but also non-metals, acid/base, other chemical compounds, fertilizer, and foods etc. N-based materials and products such as fertilizer, nitric acid and ammonia are included. KU consider that further estimation and analysis must contribute to the problem solving for N-related issues.
R12	Multilateral Agency	Policy Support	Partnerships in Environmental Management for the Seas of East Asia	Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) is an international organization that works to improve management and practices of particular relevance for the global nitrogen cycle. PEMSEA recognizes that over-enrichment of water bodies is a key challenge for sustainable coastal development in the East Asian region. PEMSEA will in particular support coordination amongst partners in the East Asian demonstration region of INMS and contribute to raising awareness and dissemination of results.
R13	Others	Science & Practices	Rothamsted Research, UK (RRES)	Rothamsted Research has a long history of leading research concerning N cycling in agricultural systems, with an emphasis on grassland-based ruminant systems at the North Wyke site. There is considerable expertise regarding ammonia, nitrous oxide and nitrate leaching emissions to the environment, farm-scale modelling and development and compilation of national scale atmospheric emission inventories. RRes has been an active participant in TFRN and EPMAN activities, particularly regarding mitigation practices over the past decade. RRes has a history of close engagement with China regarding excessive N use in Chinese agriculture, continuing now in the UK-China Newton Fund 'CINAG' project.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
R14	Others	Science & Dissemination	Society of Nature Conservation of India. (SCON) incorporating Indian Nitrogen Group working in partnership with: • IPU University, New Delhi • Chilika Development Authority and School of Biotechnology, KIIT Univ. • Indian Agricultural Research Institute, New Delhi, India • Center for Sustainable Technologies, Indian Institute of Science, Bangalore • Punjab Agricultural University/Indian Nitrogen Group • South Asian Co-operative Environment Program (SACEP)	Widespread use of synthetic fertilizers to boost crop production has resulted bin excessive damage to air and water quality. The South Asian Demonstration led by N. Raghuram and YP Abrol from the Society for Conservation of Nature (SCON), a registered NGO competent to receive grants and submit accounts, and the umbrella organization that runs the Indian Nitrogen Group and the South Asian N Centre. SCON has earlier received grants from UNEP for South Asian N workshop and N2010. The contribution will a) coordinate the South Asian Case study (INI Centre Director), comparing the challenges for nitrogen management faced by adjacent states, b) develop a N-FOOTPRINT tool for India so as to create awareness in the public, researchers and policymakers to improve NUE, food chain efficiency and consider changes in diet patterns.
R15	Others	Science & Practices	Bangladesh Rice Research Institute (BRRI), Bangladesh	Rice is the main food in Bangladesh and Bangladesh Rice Research Institute is the mandatory organization to do research on every aspect of rice for production of more rice in Bangladesh and to feed the nation. This institute is equipped with highly trained manpower and lab facilities. BRRI will contribute Towards INMS for efficient N management in rice and to reduce its abuse. At present BRRI is also working with IFDC on NO_x emission from rice field and on its mitigation.
R16	Others	Science & Practices	CSIR-National Environmental Engineering Research Institute (CSIR-NEERI), India	CSIR-NEERI has extensive experience in executing mega projects in solid waste management, analysis, land-fill engineering and emission inventory. CSIR-NEERI is the apex Government organization in India on environmental matters. The principal investigator contributing to Towards INMS is a leading expert on waste management and its interactions with the nitrogen cycle.
R17	Multilateral Agency	Policy Support	South Asia Co-operative Environment Programme	The South Asian Cooperative Environmental Programme (SACEP) is the main intergovernmental body promoting environmental cooperation in South Asia. As such they provide a key stakeholder receiver of the INMS South Asian demonstration activity. SACEP will contribute as an advisor to Component 3, providing support for wider dissemination and awareness raising of the work.
R18	Others	Science, Practices & Policy support	Earth System Science Centre/National Institute For Space Research (CCST-IPNE), Brazil working in partnership with: • the Brazilian Ministry of Science, Technology and Innovation (MCTI), • the University of Sao Paulo, • the University of Brasilia, • the University of Buenos Aires, • the InterAmerican Institute for Global Change Research, • Centro de Solos e Recursos Ambientais - Instituto Agronômico • Agro-Pastoril Paschoal Campanelli S/A	The mission is to generate interdisciplinary knowledge for national development with equity, and to reduce environmental impacts on the Earth. Its objectives are to conduct studies to evaluate the impacts of global and regional environmental change on the socio-economic and environmental systems, especially those associated with national development and wellbeing. In Towards INMS the focus is on deepening the understanding of how anthropogenic changes in the environment alter the distribution and functionality of the life on tropical biomes, consequently changing the biogeochemical nitrogen cycle, in relation to the capability to provide environmental services. (Director INI Center for Latin America). Leading the development of the Latin American INMS Regional Demonstration.
			CASE 2: Developing regions with insufficient reactive nitrogen	
R19	Multilateral Agency	Science & Practice	International Institute for Tropical Agriculture (IITA) (part of CGIAR), Kenya	IITA has several ongoing activities in the Lake Victoria catchment that fit in the context of Towards INMS. In addition, one of the IITA scientists is coordinating the activities of the Africa Regional Centre of the International Nitrogen Initiative; his work also fits well into Towards INMS. IITA has also established a strong partnership with many development partners interest in N management for improve food and energy production without pollution. The contribution of IITA will mainly focus on scaling up technologies intended to improve N agronomic efficiency in the context of too little N to minimize land degradation and environmental pollution.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
R20	Multilateral Agency	Science support	International Livestock Research Institute (ILRI) (part of CGIAR), Kenya In cooperation with the Institute of Meteorology and Climate Research (IMK-IFU), Karlsruhe Institute of Technology.	ILRI works since decades on livestock production systems in Africa, with a particular focus on East Africa, including the Lake Victoria region. In the last years ILRI established a new research direction focusing on nutrient balances, use of manure for feed food production, and quantifying environmental footprints of livestock production systems including effects of land use change. In this context ILRI also worked on nitrogen balances for the Lake Victoria watershed and entire Africa. In close cooperation with the Institute of Meteorology and Climate Research (IMK-IFU), ILRI has the capacity to run biogeochemical models at regional scale for quantifying and assessing N flows.
R21	Multilateral Agency	Practice & Policy Support	Lake Victoria Basin Commission (LVBC), Kenya	The institution of East African Community mandated to coordinate different actors for sustainable development of people and resources within Lake Victoria Basin. Some of the Mandates are on water resources, environment and Natural resources. LVBC has acquired experiences on Nitrogen deposition through different projects implemented under LVBC coordination. These projects include LVEMP I and LVEMP II world Bank funded projects; USAID funded projects and National initiatives. Through these projects LVBC has data and other information related to nitrogen management in the Lake Victoria that can be shared. LVBC has experts that can be used to collect data, analyze and provide information. Ongoing LVBC projects will build synergy to the 'Towards INMS' project; and therefore provide more information on atmospheric deposition in the Lake Victoria which is thought to contribute 80% of the total N in Lake Victoria.
R22	Others	Science & Practices	Karlsruhe Institute of Technology, IMK-IFU, Germany	The Institute of Meteorology Karlsruhe (IMK-IFU) is based at Garmisch-Partenkirchen, Germany, providing world leading expertise on biosphere-atmosphere-hydrosphere interactions in the nitrogen cycle. They combine measurement and modelling expertise and will contribute to the synthesis activities of INMS, especially A2.3 (preparation of consolidated global assessment) and the East African demonstration under Component 3. IMK-IFU works closely in conjunction with the International Livestock Research Institute (ILRI), Nairobi.
R23	Others	Science & Practices	Ghent University (UGENT)	Research on process understanding of N-cycle, N-excess (N-deposition, NO_3 leaching, N_2O emission) and fertilizer N use efficiency, with substantial international experience with use of state of the art isotope based tools. The current focus is especially towards Africa including N deposition and N process work (incl. N_2O) in tropical mountain forests, nitrate source apportionment (Lake Victoria and Nyungwe forest) and biological N_2 fixation for sustainable agricultural intensification for smallholder farmers. The focus of the UGENT contribution to INMS will be the use of nitrate and boron isotopes to apportion source of nitrate in Kenyan rivers draining to Lake Victoria. This would contribute to constraining the N budget of lake Victoria. UGENT has experience in the analyses of isotopes in nitrate and the use of Bayesian isotopic mixing models to quantify nitrate sources. Currently UGENT is working with on rivers in Kenya already via an IAEA funded project and training program.
R24	Others	Science & Practices	Laboratoire d'Aérologie Observatoire Midi-Pyrénées (LA UMR)	Contribution to case studies for developed countries with insufficient N_r: West and Central Africa and Lake Victoria (LV) case studies. Key issues: air quality, greenhouse gas balance, atmospheric emission and deposition of N_r. Experience and partnership: coordination of the long term monitoring deposition network IDAF (IGAC-DEBITS-Africa), label WMO, partner of EADN (Equatorial Atmospheric Deposition Network), GEF UNEP Project. A French national proposal has been submitted for a pilot study in the LV catchment (partners: ILRI, University of Nairobi). Scientific objectives: N_r emission, wet and dry deposition measurements above soil and water, Atmospheric N_r budget and GES balance.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
			CASE 3: Nitrogen challenges for transition economies	
R25	Others	Science & Practices	Odessa National I. I. Mechnikov University (ONU), Ukraine	ONU has large experience the Eastern Europe regional demonstration: 1) the Low Dniester basin (INTAS Project “Development of New Methods to Process Information about the Quality of Water in River Basins”; EU-TACIS Project «Technical Assistance for the Lower Dniester Basin Management Planning»; EU-FP6 NitroEurope, EU-FP7 ECLAIRE and 2) the Low Danube basin (EU-TACIS Project «Lower Danube Lakes: Sustainable Restoration and Protection of Habitats and Ecosystems»). Responsible for integrated monitoring in North-Western part of the Black Sea basin, most recently the FP7 PERSEUS Project “Policy-oriented marine Environmental Research for the Southern European Seas” and UNDP-EU EMBLAS Project «Improving Environmental Monitoring in the Black Sea” and UNDP-EU EMBLAS-II Project «Improving Environmental Monitoring in the Black Sea» (2014-present). Activities include a permanent state-of-the-art research station "Petrodolinskoe" and three sites for atmospheric deposition collection and river water sampling in the Low Dniester basin, as well as the integrated monitoring station "Zmiinyi Island" located in the North-Western part of the Black Sea.
R26	Others	Science & Practices	Institute of agroecology and environmental management of National Academy of Agrarian Sciences (IAEM), Ukraine	Research at IAEM is aimed to increase the role of the environmental component of agriculture in Ukraine. As a result of the use of mineral nitrogen fertilizers, industry production and the number of farm animals, the problem of eutrophication of water sources is particularly acute. This indicates the loss of nitrogen throughout the all nitrogen cycle. The contribution focuses on the East Europe regional demonstration (Dniester, Prut and Lower Danube). The activity aims to demonstrate how a cross cutting approach that joins up different parts of the nitrogen cycle, including the benefits and threats, can deliver a stronger gravity for better management of these issues. Approaches for evaluating of nitrogen flows will be developed at the level of regional demonstration.
R27	Non-ministry public body	Science & Practices	Federal State Budget Scientific Institution “Institute for Engineering and Environmental Problems in Agricultural Production” (IEEP), Russia	Focus on nitrogen flux control as a part of environmental management on a farm level, including methods of environmental assessment of agricultural enterprises based on NUE (nitrogen budgets) and the guidelines for improved manure management on large-scale livestock farms in compliance with relevant national and international legislation, with the outputs being tested on several pilot farms. (Co-chair of the UNECE Expert Panel on Nitrogen in EECCA countries, EPN-EECCA).
R28	Non-ministry public body	Science & Practices	Federal State Budget Scientific Institution “All-Russian Scientific Research Institute for Organic Fertilizers and Peat” (VNIIOU), Russia	Research and Development with estimation of N balance and cycle for different organic and mineral fertilization schemes in long-term field experiments (LTE) and development of measures which decrease atmospheric loss and leaching in groundwater of mineral N applied with organic fertilizers and prevent losses under storage of organic fertilizers. R&D to construct the model of N dynamics in conventional, organic and intensive farming. Estimation of N balance in Russian agriculture (Co-chair of the EPN-EECCCA). Highly relevant is the ongoing joint project with IEEP and UBA-Germany ‘EECCA BAT IRPP’ on Best Available Techniques for intensive rearing of pig, poultry and cattle in EECCA countries.

#[53]	Sources of Co-financing	Type	Name of Partner	Nature of Contribution
R29	Others	Science Support	Scientific Research Institute for Atmospheric Air Protection (SRI), Russia	Interest in developing an understanding of the processes of the global nitrogen cycle. Main activities: Accounting of national emissions; Modelling of air pollutant transport and deposition using EMEP model and CMAQ, meteorological models MM5 and WRF. Recent projects include: Russian-Swedish project “Development of the Co-operation within the Convention on Long Range Transboundary Air Pollution” implementation of the GAINS model in the Russian Federation; EECCA project "Facilitating the implementation and ratification of the protocols of the Convention on Long-Range Transboundary Air Pollution in Eastern Europe, Caucasus and Central Asia”; “Support in creating national emission inventory system needed for joining CLRTAP protocols and meeting corresponding reporting commitments”; “Review of existing and required capacities for addressing adverse environmental impact of transboundary air pollution in North-East Asia” under the UNESCAP North-East Asian Sub-regional Programme for Environ. Cooperation.
R30	Multilateral Agency	Policy & Practices Support	Commission on the Protection of the Black Sea Against Pollution (BSC PS), Turkey	Is a key user of the outcomes of ‘Towards INMS’ and at the same time will share datasets and facilitate knowledge exchange to support the East Europe INMS demonstration, which focuses on the Dniester, Prut and Lower Danube which flow in to the Black Sea.
			CASE 4: Nitrogen challenges for developed regions with excess reactive nitrogen [without GEF resources]	
R31	Others	Science & Practices	University Pierre and Marie Curie (UPMC), France	The METIS lab, in association with the Center of National Research (CNRS), is focusing its activity on hydrogeophysical and biogeochemical modelling including ecological modelling experimentally-based approach (Riverstrahler), taking explicitly the processes of microorganisms involved in the C, N, P, Si and oxygen cycles. The model links the water quality of river continuums from land-to-sea with human activities in the basin (water pollution by domestic effluents, agriculture contaminations). The nitrogen cascade and the nitrogen cycle in the water-agri-food have received major attention in the last 5 years, from local to global scales. The interest of the group includes analysis of the performance of organic agriculture in terms of N losses in the environment. Leads the West Europe regional demonstration activity.
R32	Others	Science & Practices	Technical University of Madrid / Universidad Politécnica de Madrid (UPM), Spain	UPM has developed different research programs related to the development of sustainable management practices for agriculture. Primary areas of experience include carbon and nitrogen dynamics in agroecosystems, nitrogen loss in the form of NO_3^- leaching and emissions of N_2O, NO_x and NH_3, greenhouse gas exchanges (CO_2, CH_4 and N_2O) and carbon sequestration in agroecosystems, soil resource sustainability as influenced by land management (e.g. conservation agriculture practices). UPM research will bring to ‘Towards INMS’ valuable technical experience base on its expertise areas and results from ongoing field experiments.
R33	Others	Science, Practicies & Policy Support	Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (CIEMAT), Spain	The is focused on quantifying the interactive effects of ozone and nitrogenous compounds on Mediterranean vegetation and defining air pollutant threshold values (critical loads and levels) for the protection of ecosystems. Our group has experience on atmospheric nitrogen deposition, particularly dry deposition. We are investigating the interactive effects of ozone and nitrogen enrichment on yield and quality of crops. We are interested in the influence of climate change and air pollution on carbon and nitrogen cycles and soil-plant-atmosphere interactions in Mediterranean forests ecosystems and crops. This group has hold different agreements since 2001 with the Spanish Ministry of Environment with the objective to apply and adapt the methodologies developed under the LRTAP Convention.

Section 6: Monitoring and Evaluation Plan

182. The project will follow UNEP standard monitoring, reporting and evaluation processes and procedures. Substantive and financial project reporting requirements are summarized in Appendix 7 of the Project Document. Reporting requirements and templates are an integral part of the UNEP legal instruments to be signed by the executing agency (CEH on behalf of INI) and UNEP. For the purposes of M&E activities (and the reading of this document), the Project Co-ordinator will function under the direct supervision and control of the Project Director to fulfil the M&E needs.

183. The project M&E plan is consistent with the GEF Monitoring and Evaluation policy. The Project Results Framework presented in Appendix 4 includes Specific, Measurable, Achievable, Relevant and Time-bound (SMART) indicators and targets for each expected outcome. These indicators along with the key deliverables and benchmarks included in Appendix 6 will be the main tools for assessing project implementation progress and whether project results are being achieved. The means of verification and the costs associated with obtaining the information to track the indicators are summarized in the tables at the end of this appendix (sections 4 and 5 of this appendix). M&E related costs are presented and are fully integrated in the overall project budget.

184. The M&E plan will be presented to the first meeting of the Project Management Board (PMB) to ensure project stakeholders understand their roles and responsibilities vis-à-vis project monitoring and evaluation. The PMB will be responsible for proposing to UNEP management any necessary amendments to the M&E plan during project implementation. Indicators and their means of verification may also be fine-tuned by the PMB. Day-to-day project monitoring is the responsibility of the PCU but other project partners will have responsibilities to collect specific information to track the indicators. It is the responsibility of the Project Co-ordinator to inform UNEP of any delays or difficulties faced during implementation so that the appropriate support or corrective measures can be adopted in a timely fashion.

185. The PMB will receive periodic reports on progress and will make recommendations to UNEP concerning the need to revise any aspects of the Results Framework or the M&E plan. Project oversight to ensure that the project meets UNEP and GEF policies and procedures is the responsibility of the UNEP Task Manager. The Task Manager will also review the quality of draft project outputs, provide feedback to the project partners, and establish peer review procedures to ensure adequate quality of scientific and technical outputs and publications.

186. The UNEP Task Manager will develop a project supervision plan at the inception of the project, which will be communicated to the project partners during the first meeting of the PMB. The Project Co-ordinator will also be responsible for initial screening of the financial and administrative reports from the core partners prior to their submission to the Finance and Management Divisions of the United Nations Office at Nairobi. Progress vis-à-vis the delivery of agreed project outputs will be assessed by the PMB and endorsed by the PPA at least annually. Project risks and assumptions will be regularly reviewed both by project partners and the PCU on behalf of UNEP. Risk assessment and rating is an integral part of the annual Project Implementation Review (PIR), preparation of which will be the responsibility of the Project Manager. The quality of project monitoring and evaluation will be reviewed and rated as part of the PIR, which will be approved by the PMB. Key financial parameters will be monitored quarterly to ensure cost-effective use of financial resources.

187. A Mid-term Review (MTR) or Mid-term Evaluation (MTE) will be organised by the UNEP Evaluation Office or the Task Manager in consultation with the Project Co-ordinator and the outcomes reported to the Project Management Board. The review/evaluation will include all parameters recommended by the GEF Evaluation Office for terminal evaluations and will verify information gathered through the GEF tracking tools, as relevant. The purpose of the Mid-Term Review (MTR) or Mid-Term Evaluation (MTE) is to provide an independent assessment of project performance at mid-term, to analyze whether the project is on track, what problems and challenges the project is encountering, and which corrective actions are required so that the project can achieve its intended outcomes by

project completion in the most efficient and sustainable way. In addition, it will verify information gathered through the GEF tracking tools. The review will be carried out using a participatory approach whereby parties that may benefit or be affected by the project will be consulted. Such parties were identified during the stakeholder analysis (see section 2.6 of the project document). The Project Management Board will participate in the mid-term review/evaluation and develop a management response to the evaluation recommendations along with an implementation plan. It is the responsibility of the UNEP Task Manager to monitor whether the agreed recommendations are being implemented.

188. An independent terminal evaluation will take place at the end of project implementation. The Evaluation Office (EO) of UNEP will manage the terminal evaluation (TE) process. A review of the quality of the evaluation report will be done by EO and submitted along with the report to the GEF Evaluation Office not later than 6 months after the completion of the evaluation. The TE will provide an independent assessment of project performance (in terms of relevance, effectiveness and efficiency), and determine the likelihood of impact and sustainability. It will have two primary purposes:

- to provide evidence of results to meet accountability requirements, and
- to promote learning, feedback, and knowledge sharing through results and lessons learned among UNEP and executing partners.

189. While a TE should review use of project funds against budget, it would be the role of a financial audit to assess probity (i.e. correctness, integrity etc.) of expenditure and transactions.

190. Indicative terms of reference for the terminal evaluation are included in Appendix 11. These will be adjusted to the special needs of the project.

191. The TE report will be sent to project stakeholders for comments. Formal comments on the report will be shared by the EO in an open and transparent manner. The project performance will be assessed against standard evaluation criteria using a six point rating scheme. The final determination of project ratings will be made by the EO when the report is finalised. The evaluation report will be publically disclosed and will be followed by a recommendation compliance process.

192. The GEF tracking tools are attached as Appendix 14. These will be updated at mid-term and at the end of the project and will be made available to the GEF Secretariat along with the project PIR report. As mentioned above the mid-term and terminal evaluation will verify the information of the tracking tool.

193. Indicative M&E activities and responsibilities are shown below. Further details can be found in Appendix 7.

Table 8: *Indicative M&E activities and responsibilities*

Type of M&E activity	Responsible Parties	GEF Budget US$	Time frame
Project Management Board & Project Partners Assembly Inception Workshops	Project Coordinator PCU PMB UNEP Task Manager Project Partners Assembly provides endorsement	38,000	1st PMG and PPA Meetings will serve as Inception workshop and will be held within first four months of project start up.
Inception Report	Project Coordinator PCU PMB UNEP Task Manager Project Partners Assembly provides endorsement	None	Immediately following inception workshop
Measurement of indicators set in the Project Results Framework (Project Progress	UNEP Task Manager Project Coordinator in collaboration with PCU	None	Annually prior to APR/PIR and to the definition of annual work plans

and Performance to be measured on an annual basis)			
APR and PIR	Project Coordinator & PCU UNEP Task Manager PMB	None	Annually
Periodic status reports	PCU	None	To be determined by PCU, UNEP and EAs
Technical reports/Project publications	For previously agreed reports: Component, Activity and Task Leaders as appropriate For new reports: PMB, Component, Activity & Task Leaders, Hired consultants as needed	95,950	To be determined by Project Team, UNEP and PCU, EA
Mid-Term Review	Project Coordinator & PCU UNEP Task Manager Project Partners Assembly provides endorsement External consultant	20,000	Halfway through project cycle
Terminal External Evaluation	Evaluation Team PCU UNEP Task Manager Project Partners Assembly provides endorsement External Consultants	30,000	At the end of project implementation
Terminal Report	PCU PMB UNEP Task Manager Project Partners Assembly provides endorsement External Consultant*	38,000	At least one month before the end of the project
Lessons learned	PCU UNEP Task Manager Partner executing agencies*	None	Yearly as part of the APR
Audit	UNEP Task Manager PCU EA accredited Auditor	4,000	Yearly
TOTAL indicative COST		224,500	

Section 7: Project Financing and Budget

Overall project budget

194. The following table provides a summary by component of the project budget, full details of which are provided in Appendix 1 of Annex 1 of this document.

Budget per Component - Summary Table - INMS				
	Project Components/Activities/Tasks	**GEF Funding**	**Co-Financing**	**Total Project Cost**
Component 1	Tools and Methods for the N cycle	1,400,000	24,259,170	25,659,170
Activity 1.1	Development of N System indicators	230,000	14,383,693	14,613,693
Activity 1.2	Development of threat assessment methodology	185,000	1,887,941	2,072,941
Activity 1.3	Development of methodology for N fluxes and distribution	185,000	3,377,033	3,562,033
Activity 1.4	Tools & Methods for the N cycle	120,000	996,522	1,116,522
Activity 1.5	Flux-impact path models for assessment, scenarios & strategy evaluation	455,000	2,513,226	2,968,226
Activity 1.6	Examination of the barriers achieving to better nitrogen management	110,000	1,100,754	1,210,754
Activity 1.0	Component level coordination	115,000	0	115,000
Component 2	Quantification of N flows, threats and benefits	1,680,000	16,402,475	18,082,475
Activity 2.1	Quantifying N flows, threats and benefits at global and regional scales	480,000	9,371,918	9,851,918
Activity 2.2	Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations	500,000	2,606,138	3,106,138
Activity 2.3	Integrating methods, measures & good practices to address issues of excess & insufficient Nr	260,000	1,988,217	2,248,217
Activity 2.4	Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis	180,000	1,807,044	1,987,044
Activity 2.5	Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr.	140,000	629,159	769,159
Activity 2.0	Component level coordination	120,000	0	120,000
Component 3	Regional Demonstrations	1,650,000	10,254,630	11,904,630
Activity 3.1	Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N cycle.	1,350,000	8,903,363	10,253,363
Activity 3.2	Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits	130,000	578,832	708,832
Activity 3.3	Building consensus on benchmarking N indicators for different regions and systems	70,000	303,724	373,724
Activity 3.4	Refinement of regional approach to demonstrating benefits of joined up nitrogen management.	50,000	468,712	518,712
Activity 3.0	Component level coordination	50,000	0	50,000
Component 4	Awareness raising and knowledge sharing	980,000	5,659,631	6,639,631
Activity 4.1	Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement	250,000	847,894	1,097,894
Activity 4.2	INMS training, diffusion and international relations, inc. nitrogen footprinting	165,000	2,525,060	2,690,060
Activity 4.3-4.4	Demonstration of INMS to provide support to international policy frameworks, & developmnt of long-term strategy	175,000	1,240,736	1,415,736
Activity 4.5	Harmonization, publication & dissemination of guidance documents across components	60,000	567,016	627,016
Activity 4.6-4.9	Provision of support to IW-LEARN & engagement with GEF & STAP	250,000	478,924	728,924
Activity 4.0	Component level coordination	80,000	0	80,000
	Project Management			
	Overall Day to Day Project Management through the PCU	290,000		290,000
	TOTAL PROJECT COST ($)	**6,000,000**	**56,575,907**	**62,575,907**

Project co-financing by co-financier

Partner involvement	Sources of co-financing	Type	Partner name/Name of co-financier	CASH CO-FINANCING	IN-KIND CO-FINANCING	TOTAL CO-FINANCING
			Partners primarily with global focus in the project			
C1	GEF Agency	Policy support	United Nations Environment Programme	-	1,708,000.00	1,708,000.00
C2	Non-ministry government body	Science and Policy Support	Natural Environment Research Council	1,134,378	3,820,322	4,954,700
C3	Others	Science and Policy Support	University of Edinburgh	-	3,500,000	3,500,000
D1	Other Multilateral Agency (ies)	Science	Secretariat to the Convention on Biological Diversity			
D2	Other Multilateral Agency (ies)	Policy support	UNECE Conventions on Transboundary Water and Transboundary Air Pollution	-	100,000	100,000
D3	Other Multilateral Agency (ies)	Policy support	Organisation for Economic Co-operation and develpment	-	387,000	387,000
D4	Other Multilateral Agency (ies)	Science and Policy Support	Food and Agriculture Organization of United Nation	-	1,844,247	1,844,247
D5	Other Multilateral Agency (ies)	Science	World Meteorological Organisation	-	-	-
D6	Other Multilateral Agency (ies)	Science and Policy Support	International Institute for Applied Systems Analysis	-	2,000,000	2,000,000
D7	Other Multilateral Agency (ies)	Science and Policy Support	European Commissions, Joint Research Centre	-	1,200,000	1,200,000
D8	Other Multilateral Agency (ies)	Science and Practices	The Interna tional Maize and Wheat Improvement Center	-	800,000	800,000
D9	Non-ministry government body	Science and Policy Support	PBL Netherlands Environmental Assessment Agency	-	1,250,000	1,250,000
D10	Non-ministry government body	Science and Policy Support	National Institute for Public Health and the Environment The Netherlands	-	580,000	580,000
D11	Non-ministry government body	Science and Policy Support	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	160,000	535,000	695,000
D12	Non-ministry government body	Science and Practices	National Institute for Agronomic Research	-	794,000	794,000
D13	Ministry government body	Science and Policy Support	United States Environmental Protection Agency	-	1,270,000	1,270,000
D14	Non-ministry government body	Science and Policy Support	Federal Environment Agency	-	1,352,152	1,352,152
D15	Non-ministry government body	Science and Policy Support	French Agency for Environment and Energy Management	10,000	9,000	19,000
D16	Non-ministry government body	Science	Consiglio Nazionale delle Ricerche	-	200,000	200,000
D17	Non-ministry government body	Science	Norwegian Meteorological Institute	40,000	200,000	240,000
D18	Non-ministry government body	Science and Practices	Victorian Department of Economic Development, Jobs, Transport and Resources - Agriculture Division	200,000	300,000	500,000

D19	Others	Science and Policy Support	Alterra Wageningen University and Research Centre	3,137,000	1,866,000	**5,003,000**
D20	Others	Science and Policy Support	Wageningen University and Research Centre, Livestock Research	3,286,250	426,250	**3,712,500**
D21	Others	Science and Policy Support	Energy research Centre of the Netherlands	-	1,006,250	**1,006,250**
D22	Others	Science and Policy Support	Vrije Universiteit	-	300,000	**300,000**
D23	Others	Science and Practices	Nederlandse organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek	-	600,000	**600,000**
D24	Others	Science and Policy Support	Potsdam Institute for Climate Impact Research	-	1,470,137	**1,470,137**
D25	Others	Science	University of Bonn	-	330,000	**330,000**
D26	Others	Science and Practices	Leibniz Institute for Agricultural Engineering	-	20,000	**20,000**
D27	Others	Science and Practices	Aarhus University, Department of Bioscience	-	475,000	**475,000**
D28	Others	Science and Practices	Aarhus University, Department of Agroecology	450,000	950,000	**1,400,000**
D29	Others	Science and Practices	Aarhus University, Department of Environmental Science	-	773,600	**773,600**
D30	Others	Science and Practices	Institute of Water Resources Engineering	-	5,500	**5,500**
D31	Others	Science and Practices	Agrophysical Research Institute	-	75,000	**75,000**
D32	Others	Science Support	Institute of Physicochemical and Biological Problems in Soil Science	15,000	35,000	**50,000**
D33	Others	Science and Practices	Instituto Superior de Agronomia (School of Agronomy) of the University of Lisbon	-	258,000	**258,000**
D34	Others	Science and Practices	Ataturk Horticultural Central Research Institute	65,000	40,000	**105,000**
D35	Others	Science and Practices	Fundacao da Faculdade de Ciencias da Universidade de Lisboa, FP	480,000	50,000	**530,000**
D36	Others	Policy support and Practices	Stockholm Environment Institute at York / York University	5,072	2,571,149	**2,576,221**
D37	Others	Science and Practices	University of East Anglia	-	98,000	**98,000**
D38	Others	Science, Practice and Policy Support	North American Nitrogen Center	-	2,100,000	**2,100,000**
D39	Others	Science and Policy Support	New York University	10,000	30,000	**40,000**
D40	Others	Science and Practices	World Resources Institute	-	497,000	**497,000**
D41	Others	Science and Practices	University of Missouri	133,000	295,000	**428,000**
D42	Others	Science and Practices	AgReseach Limited	100,000	450,000	**550,000**

B1	Private Sector/Business	Policy Interest and Practices	Fertilizers Europe	110,300	36,500	**146,800**
B2	Private Sector/Business	Science and Practices	Centre for Plant Nutrition Hanninghof, Yara GmbH & Co.KG, Germany	-	85,000	**85,000**
B3	Private Sector/Business	Science and Practices	BASF SE	-	100,000	**100,000**
B4	Private Sector/Business	Science and Practices	SKW Stickstoffwerke Piesteritz GmbH	-	171,000	**171,000**
B5	Private Sector/Business	Science, Policy and Practices	PigCHAMP Pro Europa S.L.	140,000	260,000	**400,000**
B6	Private Sector/Business	Policy Interest and Practices	International Fertilizer Industry Association	-	100,000	**100,000**
B7	Private Sector/Business	Science and Policy Interest	International Plant Nutrition Institute			
B8	Private Sector/Business	Practices Development	European Agricultural Machinery			
S1	Civil Society Organisation	Policy and Dissemination	Non-governmental organization New Energy	-	15,000	**15,000**
S2	Civil Society Organisation	Policy and Dissemination	World Wide Fund for Nature conservation			
S3	Civil Society Organisation	Policy and Dissemination	Planetary Boundary Initiative			
			Partners primarily with regional demonstration focus in the project			
			CASE 1: Developing regions with excess reactive nitrogen			
R1	Others	Science and Practices	Institute of Soil Science, Chinese Academy of Sciences	100,000	420,000	**520,000**
R2	Others	Science and Practices	National Institute for Agro-Environmental Sciences	30,000	170,000	**200,000**
R3	Others	Science, Practice and Policy Support	China Agricultural University	400,000	100,000	**500,000**
R4	Others	Science and Practices	China Agricultural University	20,000	50,000	**70,000**
R5	Others	Science and Support	Beijing Forestry University	-	300,000	**300,000**
R6	Others	Science and Practices	Zhejiang University	-	500,000	**500,000**
R7	Others	Science and Practices	Chinese Academy of Science, Center for Agricultural Resources Research, Institute of Genetic and Developmental	80,000	320,000	**400,000**
R8	Others	Science and Practices	Field Science Center for Northern Biosphere, Hokkaido University	-	45,000	**45,000**
R9	Others	Science and Practices	Research Faculty of Agriculture, Hokkaido University	-	10,000	**10,000**
R10	Others	Science and Practices	National Institute for Environmental Studies	10,000	10,000	**20,000**
R11	Others	Science and Practices	Kyoto University	3,000	2,000	**5,000**
R12	Multilateral Agency	Policy Support	Partnerships in Environmental Management for the Seas of East Asia			
R13	Others	Science and Practices	Rothamsted Research	300,000	450,000	**750,000**

R14	Others	Science and Dissemination	Society for Conservation of Nature	-	1,150,000	**1,150,000**
R15	Others	Science and Practices	BBRI Bangladesh	-	205,000	**205,000**
R16	Others	Science and Practices	CSIR-National Environmental Engineering Research Institute	-	60,000	**60,000**
R17	Multilateral Agency	Policy Support	South Asia Co-operative Environment Programme			
R18	Others	Science Practices and Policy Support	Earth System Science Centre/National Institute For Space Research	-	1,050,000	**1,050,000**
			CASE 2: Developing regions with insufficient reactive nitrogen			
R19	Multiulateral Agency	Science and Practices	International Institute of Tropical Agriculture	-	1,000,000	**1,000,000**
R20	Multiulateral Agency	Sciense Support	Livestock Systems and Environment International Livestock Research Institute	-	350,000	**350,000**
R21	Multilateral Agency	Practice and Policy Support	Lake Victoria Commission Secretariat	123,000	200,000	**323,000**
R22	Others	Science and Practices	Karlsruhe Institute of Technology			
R23	Others	Science and Practices	Ghent University	375,000	275,000	**650,000**
R24	Others	Science and Practices	Laboratoire d'Aérologie Observatoire Midi-Pyrénées	58,000	443,000	**501,000**
			CASE 3: Nitrogen challenges for transition economies			
R25	Others	Science and Practices	Odessa National I. I. Mechnikov University	-	70,000	**70,000**
R26	Others	Science and Practices	Institute of agroecology and environmental management of National Academy of Agrarian Sciences	-	270,000	**270,000**
R27	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution "Institute for Engineering and Environmental Problems in Agricultural	-	115,000	**115,000**
R28	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution "All-Russian Scientific Research Institute for Organic	-	150,000	**150,000**
R29	Others	Science Support	Scientific Research Institute for Atmospheric Air Protection	-	150,000	**150,000**
R30	Multilateral Agency	Policy and Practices Support	Commission on the Protection of the Black Sea Against Pollution	-	-	**-**
			CASE 4: Nitrogen challenges for developed regions with excess reactive nitrogen [without GEF resources]			
R31	Others	Science and Practices	University Pierre and Marie Curie	-	200,000	**200,000**
R32	Others	Science and Practices	Technical University of Madrid	-	90,000	**90,000**
R33	Others	Science Practices and Policy Support	Centro de Investigaciones Energéticas Medioambientales y Tecnológicas	-	106,800	**106,800**
				10,975,000	**45,600,907**	**56,575,907**

Project cost-effectiveness

195. The project represents exceptional cost-effectiveness in several ways. Firstly, it links USD 6 million GEF contribution with c USD 56 million co-financing from a global network of partners, multiplying the GEF contribution by a factor of ten. Secondly, by bringing together and establishing a global network to work toward INMS, the approach provides the critical mass to catalyze substantial change for a joined up approach to managing the global nitrogen cycle. As explained in the project Incremental Cost Analysis (Appendix 3), the global impact of human activities through alternation of the nitrogen cycle is many times the value of the project. For example, an improvement of global nitrogen use efficiency by 20% has been estimated in *Our Nutrient World* to be worth USD 170 billion per year in net economic and social benefits, including the cost savings for farmers and the environmental and health benefits.

APPENDICES

Appendix 1 & 2: GEF and CF Budget by project components and UNEP budge

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Budget per Component - Summary Table - INMS

	Project Components/Activities/Tasks	GEF Funding	Co-Financing	Total Project Cost
Component 1	Tools and Methods for the N cycle	1,400,000	24,259,170	25,659,170
Activity 1.1	Development of N System indicators	230,000	14,383,693	14,613,693
Activity 1.2	Development of threat assessment methodology	185,000	1,887,941	2,072,941
Activity 1.3	Development of methodology for N fluxes and distribution	185,000	3,377,033	3,562,033
Activity 1.4	Tools & Methods for the N cycle	120,000	996,522	1,116,522
Activity 1.5	Flux-impact path models for assessment, scenarios & strategy evaluation	455,000	2,513,226	2,968,226
Activity 1.6	Examination of the barriers achieving to better nitrogen management	110,000	1,100,754	1,210,754
Activity 1.0	Component level coordination	115,000	0	115,000
Component 2	Quantification of N flows, threats and benefits	1,680,000	16,402,475	18,082,475
Activity 2.1	Quantifying N flows, threats and benefits at global and regional scales	480,000	9,371,918	9,851,918
Activity 2.2	Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations	500,000	2,606,138	3,106,138
Activity 2.3	Integrating methods, measures & good practices to address issues of excess & insufficient Nr	260,000	1,988,217	2,248,217
Activity 2.4	Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis	180,000	1,807,044	1,987,044
Activity 2.5	Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr.	140,000	629,159	769,159
Activity 2.0	Component level coordination	120,000	0	120,000
Component 3	Regional Demonstrations	1,650,000	10,254,630	11,904,630
Activity 3.1	Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N cycle.	1,350,000	8,903,363	10,253,363
Activity 3.2	Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits	130,000	578,832	708,832
Activity 3.3	Building consensus on benchmarking N indicators for different regions and systems	70,000	303,724	373,724
Activity 3.4	Refinement of regional approach to demonstrating benefits of joined up nitrogen management.	50,000	468,712	518,712
Activity 3.0	Component level coordination	50,000	0	50,000
Component 4	Awareness raising and knowledge sharing	980,000	5,659,631	6,639,631
Activity 4.1	Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement	250,000	847,894	1,097,894
Activity 4.2	INMS training, diffusion and international relations, inc. nitrogen footprinting	165,000	2,525,060	2,690,060
Activity 4.3-4.4	Demonstration of INMS to provide support to international policy frameworks, & developmnt of long-term strategy	175,000	1,240,736	1,415,736
Activity 4.5	Harmonization, publication & dissemination of guidance documents across components	60,000	567,016	627,016
Activity 4.6-4.9	Provision of support to IW-LEARN & engagement with GEF & STAP	250,000	478,924	728,924
Activity 4.0	Component level coordination	80,000	0	80,000
	Project Management			
	Overall Day to Day Project Management through the PCU	290,000		290,000
	TOTAL PROJECT COST ($)	6,000,000	56,575,907	62,575,907

RECONCILIATION BETWEEN GEF ACTIVITY BASED BUDGET AND UNEP BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project No:

Project Name: Towards the International Nitrogen Management System

Executing Agency: NERC Centre for Ecology & Hydrology

Source of funding: GEF

		BUDGET ALLOCATION BY PROJECT COMPONENT						ALLOCATION BY CALENDAR YEAR			
		1	2	3	4	PCU	Total	Year 1	Year 2	Year 3	Year 4
UNEP BUDGET LINE/OBJECT OF EXPENDITURE		US$	US$	US$	US$	US$	US$	US$	US$	US$	US$
1161	**STAFF & OTHER PERSONNEL**										
	C1 - Tools and Methods for the N cycle	130,000					130,000	33,000	35,000	34,000	28,000
	C2 - Quantification of N flows, threats and benefits		225,000				225,000	57,000	57,000	62,000	49,000
	C3 - Regional Demonstrations			135,000			135,000	-	12,000	63,000	60,000
	C4 - Awareness raising and knowledge sharing				495,000		495,000	145,000	116,000	122,000	112,000
	Project Management - PCU					290,000	290,000	72,500	72,500	72,500	72,500
	Sub-total	130,000	225,000	135,000	495,000		1,275,000	307,500	292,500	353,500	321,500
1561	**TRAVEL**										
	C1 - Tools and Methods for the N cycle	154,000	-	-			154,000	38,000	57,000	42,000	17,000
	C2 - Quantification of N flows, threats and benefits	-	238,000	-	-		238,000	63,000	70,000	60,000	45,000
	C3 - Regional Demonstrations	-	-	85,000	-		85,000	-	15,000	70,000	-
	C4 - Awareness raising and knowledge sharing	-	-	-	80,000		80,000	12,000	23,000	19,000	26,000
	Sub-total	154,000	238,000	85,000	80,000		557,000	113,000	165,000	191,000	88,000
2161	**CONTRACTUAL SERVICES (INCLUDING DATABASES)**										
	C1 - Tools and Methods for the N cycle	-	-	-	-		-	-	-	-	-
	C2 - Quantification of N flows, threats and benefits	-	96,000	-	-		96,000	24,000	14,000	14,000	44,000
	C3 - Regional Demonstrations	-	-	-	-		-	-	-	-	-
	C4 - Awareness raising and knowledge sharing	-	-	-	80,000		80,000	15,000	25,000	15,000	25,000
	Sub-total	-	96,000	-	80,000		176,000	39,000	39,000	29,000	69,000
2261	**GRANTS TO IMPLEMENTING PARTNERS**										
	C1 - Tools and Methods for the N cycle	1,096,000	-	-	-		1,096,000	238,000	380,000	418,000	60,000
	C2 - Quantification of N flows, threats and benefits	-	1,065,000	-	-		1,065,000	243,000	372,000	337,000	113,000
	C3 - Regional Demonstrations	-	-	1,430,000	-		1,430,000	335,000	355,000	380,000	360,000
	C4 - Awareness raising and knowledge sharing	-	-	-	150,000		150,000	63,000	34,000	29,000	24,000
	Sub-total	1,096,000	1,065,000	1,430,000	150,000		3,741,000	879,000	1,141,000	1,164,000	557,000
4161	**MATERIALS & SUPPLIES**										
	C1 - Tools and Methods for the N cycle	20,000	-	-	-		20,000	4,000	6,000	6,000	4,000
	C2 - Quantification of N flows, threats and benefits	-	56,000	-	-		56,000	3,000	3,000	2,000	48,000
	C3 - Regional Demonstrations	-	-	-	-		-	-	-	-	-
	C4 - Awareness raising and knowledge sharing	-	-	-	70,000		70,000	15,000	15,000	20,000	20,000
	Sub-total	20,000	56,000	-	70,000		146,000	22,000	24,000	28,000	72,000
4261	**NON EXPENDABLE EQUIPMENT (FURNITURE, EQUIPMENT)**										
	C1 - Tools and Methods for the N cycle	-	-	-	-		-	-	-	-	-

UNEP BUDGET LINE/OBJECT OF EXPENDITURE		BUDGET ALLOCATION BY PROJECT COMPONENT 1	2	3	4	PCU	Total	ALLOCATION BY CALENDAR YEAR Year 1	Year 2	Year 3	Year 4
		US$	US$	US$	US$	US$	US$	US$	US$	US$	US$
	C2 - Quantification of N flows, threats and benefits	-	-	-	-		-	-	-	-	-
	C3 - Regional Demonstrations	-	-	-	-		-	-	-	-	-
	C4 - Awareness raising and knowledge sharing	-	-	-			-				
	Sub-total	-	-	-	-		-	-	-	-	-
5161	**OTHER DIRECT OPERATING COSTS (TELECONFERENCE CALLS)**										
	C1 - Tools and Methods for the N cycle	-	-	-	-		-	-	-	-	-
	C2 - Quantification of N flows, threats and benefits	-	-	-	-		-	-	-	-	-
	C3 - Regional Demonstrations	-	-	-	-		-	-	-	-	-
	C4 - Awareness raising and knowledge sharing	-	-	-	55,000		55,000	55,000	-	-	-
	Sub-total	-	-	-	55,000		55,000	55,000	-	-	-
5581	**EVALUATION (CONSULTANTS FEES/TRAVEL/DSA/ADMIN SUPPORT)**										
	C1 - Tools and Methods for the N cycle	-	-	-	-		-	-	-	-	-
	C2 - Quantification of N flows, threats and benefits	-	-	-	-		-	-	-	-	-
	C3 - Regional Demonstrations	-	-	-	-		-	-	-	-	-
	C4 - Awareness raising and knowledge sharing	-	-	-	50,000		50,000	-	20,000	-	30,000
	Sub-total	-	-	-	50,000		50,000	-	20,000	-	30,000
	TOTAL COSTS	**1,400,000**	**1,680,000**	**1,650,000**	**980,000**		**6,000,000**	**1,415,500**	**1,681,500**	**1,765,500**	**1,137,500**

* Provide description of component/activity** Insert actual year and add additional years as required

Total	Check
US$	
130,000	0
225,000	0
135,000	0
495,000	0
290,000	0
1,275,000	0
	0
154,000	0
238,000	0
85,000	0
80,000	0
557,000	0
	0
-	0
96,000	0
-	0
80,000	0
176,000	0
	0
1,096,000	0
1,065,000	0
1,430,000	0
150,000	0
3,741,000	0
	0
20,000	0
56,000	0
-	0
70,000	0
146,000	0
	0
-	0

* Provide description of component/activity** Insert actual year and add additional years as required

Total	Check
US$	
-	0
-	0
-	0
-	0
	0
-	0
-	0
-	0
55,000	0
55,000	0
	0
-	0
-	0
-	0
50,000	0
50,000	0
6,000,000	**0**

COMPONENT 1. RECONCILIATION BETWEEN GEF ACTIVITY BASED BUDGET AND UNEP BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project No:
Project Name: Towards the Intarnational Nitrogen Management System
Executing Agency: NERC Centre for Ecology & Hydrology

Source of funding: GEF

		COMPONENT 1. BUDGET ALLOCATION BY ACTIVITY								ALLOCATION BY CALENDAR YEAR					Check
		A1.1	A1.2	A1.3	A1.4	A1.5	A1.6	A1.0	Total	Year 1	Year 2	Year 3	Year 4	Total	
UNEP BUDGET LINE/OBJECT OF EXPENDITURE		US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	
1161	**STAFF & OTHER PERSONNEL**														
	A1.1 Development of N System indicators	20,000							20,000	5,000	5,000	5,000	5,000	20,000	0
	A1.2 Development of threat assessment methodology		20,000						20,000	5,000	5,000	5,000	5,000	20,000	0
	A1.3 Development of methodology for N fluxes and distribution			20,000					20,000	5,000	5,000	5,000	5,000	20,000	0
	A1.4 Tools & Methods for the N cycle				15,000				15,000	3,000	4,000	4,000	4,000	15,000	0
	A1.5 Flux-impact path models for assessment, scenarios & strategy evaluation					35,000			35,000	10,000	10,000	10,000	5,000	35,000	0
	A1.6 Examination of the barriers achieving to better nitrogen management						10,000		10,000	2,000	3,000	3,000	2,000	10,000	0
	A1.0 Component level coordination							10,000	10,000	3,000	3,000	2,000	2,000	10,000	0
	Sub-total	**20,000**	**20,000**	**20,000**	**15,000**	**35,000**	**10,000**	**10,000**	**130,000**	**33,000**	**35,000**	**34,000**	**28,000**	**130,000**	**0**
1561	**TRAVEL**														0
	A1.1 Development of N System indicators	40,000							40,000	10,000	10,000	10,000	10,000	40,000	0
	A1.2 Development of threat assessment methodology		32,000						32,000	5,000	17,000	8,000	2,000	32,000	0
	A1.3 Development of methodology for N fluxes and distribution			32,000					32,000	5,000	8,000	17,000	2,000	32,000	0
	A1.4 Tools & Methods for the N cycle				10,000				10,000	1,000	6,000	3,000	-	10,000	0
	A1.5 Flux-impact path models for assessment, scenarios & strategy evaluation					30,000			30,000	15,000	10,000	3,000	2,000	30,000	0
	A1.6 Examination of the barriers achieving to better nitrogen management						10,000		10,000	2,000	6,000	1,000	1,000	10,000	0
	A1.0 Component level coordination								-	-	-	-	-	-	0
	Sub-total	**40,000**	**32,000**	**32,000**	**10,000**	**30,000**	**10,000**	**-**	**154,000**	**38,000**	**57,000**	**42,000**	**17,000**	**154,000**	**0**
2161	**CONTRACTUAL SERVICES (INCLUDING DATABASES)**														0
	A1.1 Development of N System indicators	N/A							-					-	0
	A1.2 Development of threat assessment methodology		N/A						-					-	0
	A1.3 Development of methodology for N fluxes and distribution			N/A					-					-	0
	A1.4 Tools & Methods for the N cycle				N/A				-					-	0
	A1.5 Flux-impact path models for assessment, scenarios & strategy evaluation					N/A			-					-	0
	A1.6 Examination of the barriers achieving to better nitrogen management						N/A		-					-	0
	A1.0 Component level coordination						-	N/A	-					-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
2261	**GRANTS TO IMPLEMENTING PARTNERS**														0
	A1.1 Development of N System indicators	160,000							160,000	35,000	75,000	40,000	10,000	160,000	0
	A1.2 Development of threat assessment methodology		130,000						130,000	30,000	70,000	30,000	-	130,000	0
	A1.3 Development of methodology for N fluxes and distribution			130,000					130,000	20,000	40,000	60,000	10,000	130,000	0
	A1.4 Tools & Methods for the N cycle				93,000				93,000	15,000	25,000	38,000	15,000	93,000	0
	A1.5 Flux-impact path models for assessment, scenarios & strategy evaluation					390,000			390,000	100,000	120,000	170,000	-	390,000	0
	A1.6 Examination of the barriers achieving to better nitrogen management						88,000		88,000	10,000	20,000	50,000	8,000	88,000	0
	A1.0 Component level coordination						-	105,000	105,000	28,000	30,000	30,000	17,000	105,000	0
	Sub-total	**160,000**	**130,000**	**130,000**	**93,000**	**390,000**	**88,000**	**105,000**	**1,096,000**	**238,000**	**380,000**	**418,000**	**60,000**	**1,096,000**	**0**
4161	**MATERIALS & SUPPLIES**														0
	A1.1 Development of N System indicators	10,000							10,000	3,000	2,000	2,000	3,000	10,000	0
	A1.2 Development of threat assessment methodology		3,000						3,000	1,000	1,000	1,000	-	3,000	0
	A1.3 Development of methodology for N fluxes and distribution			3,000					3,000	-	1,000	1,000	1,000	3,000	0
	A1.4 Tools & Methods for the N cycle				2,000				2,000	-	1,000	1,000	-	2,000	0
	A1.5 Flux-impact path models for assessment, scenarios & strategy evaluation					-			-	-	-	-	-	-	0
	A1.6 Examination of the barriers achieving to better nitrogen management						2,000		2,000	-	1,000	1,000	-	2,000	0
	A1.0 Component level coordination						-	-	-	-	-	-	-	-	0
	Sub-total	**10,000**	**3,000**	**3,000**	**2,000**	**-**	**2,000**	**-**	**20,000**	**4,000**	**6,000**	**6,000**	**4,000**	**20,000**	**0**
4261	**NON EXPENDABLE EQUIPMENT (FURNITURE, EQUIPMENT)**														0
	A1.1 Development of N System indicators	N/A							-					-	0
	A1.2 Development of threat assessment methodology		N/A						-					-	0
	A1.3 Development of methodology for N fluxes and distribution			N/A					-					-	0
	A1.4 Tools & Methods for the N cycle				N/A				-					-	0
	A1.5 Flux-impact path models for assessment, scenarios & strategy evaluation					N/A			-					-	0
	A1.6 Examination of the barriers achieving to better nitrogen management						N/A		-					-	0

	A1.0 Component level coordination						-	N/A	-					-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
5161	**OTHER DIRECT OPERATING COSTS (TELECONFERENCE CALLS)**														0
	A1.1 Development of N System indicators	N/A							-					-	0
	A1.2 Development of threat assessment methodology		N/A						-					-	0
	A1.3 Development of methodology for N fluxes and distribution			N/A					-					-	0
	A1.4 Tools & Methods for the N cycle				N/A				-					-	0
	A1.5 Flux-impact path models for assessment, scenarios & strategy evaluation					N/A			-					-	0
	A1.6 Examination of the barriers achieving to better nitrogen management						N/A		-					-	0
	A1.0 Component level coordination						-	N/A	-					-	0
	Sub-total	-	-	-	-	-	-	-	-	-	-	-	-	-	0
5581	**EVALUATION (CONSULTANTS FEES/TRAVEL/DSA/ADMIN SUPPORT)**														0
	A1.1 Development of N System indicators	N/A							-					-	0
	A1.2 Development of threat assessment methodology		N/A						-					-	0
	A1.3 Development of methodology for N fluxes and distribution			N/A					-					-	0
	A1.4 Tools & Methods for the N cycle				N/A				-					-	0
	A1.5 Flux-impact path models for assessment, scenarios & strategy evaluation					N/A			-					-	0
	A1.6 Examination of the barriers achieving to better nitrogen management						N/A		-					-	0
	A1.0 Component level coordination						-	N/A	-					-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
	TOTAL COSTS	**230,000**	**185,000**	**185,000**	**120,000**	**455,000**	**110,000**	**115,000**	**1,400,000**	**313,000**	**478,000**	**500,000**	**109,000**	**1,400,000**	**-**

COMPONENT 2. RECONCILIATION BETWEEN GEF ACTIVITY BASED BUDGET AND UNEP BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project No:
Project Name: Towards the Intarnational Nitrogen Management System
Executing Agency: NERC Centre for Ecology & Hydrology

Source of funding: GEF

		COMPONENT 2. BUDGET ALLOCATION BY ACTIVITY							ALLOCATION BY CALENDAR YEAR					Check
		A2.1	A2.2	A2.3	A2.4	A2.5	A2.0	Total	Year 1	Year 2	Year 3	Year 4	Total	
	UNEP BUDGET LINE/OBJECT OF EXPENDITURE	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	
1161	**STAFF & OTHER PERSONNEL**													
	A2.1 Quantifying N flows, threats and benefits at global and regional scales	60,000						60,000	15,000	15,000	15,000	15,000	60,000	0
	A2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstra		90,000				-	90,000	20,000	25,000	30,000	15,000	90,000	0
	A2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr			30,000			-	30,000	9,000	7,000	7,000	7,000	30,000	0
	A2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis				20,000			20,000	5,000	5,000	5,000	5,000	20,000	0
	A2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr.					15,000		15,000	5,000	3,000	3,000	4,000	15,000	0
	A2.0 Component level coordination						10,000	10,000	3,000	2,000	2,000	3,000	10,000	0
	Sub-total	**60,000**	**90,000**	**30,000**	**20,000**	**15,000**	**10,000**	**225,000**	**57,000**	**57,000**	**62,000**	**49,000**	**225,000**	**0**
1561	**TRAVEL**													0
	A2.1 Quantifying N flows, threats and benefits at global and regional scales	30,000						30,000	10,000	10,000	10,000	-	30,000	0
	A2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstra		130,000				-	130,000	30,000	35,000	35,000	30,000	130,000	0
	A2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr			50,000			-	50,000	10,000	20,000	10,000	10,000	50,000	0
	A2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis				25,000			25,000	10,000	5,000	5,000	5,000	25,000	0
	A2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr.					3,000		3,000	3,000	-	-	-	3,000	0
	A2.0 Component level coordination						-	-	-	-	-	-	-	0
	Sub-total	**30,000**	**130,000**	**50,000**	**25,000**	**3,000**	**-**	**238,000**	**63,000**	**70,000**	**60,000**	**45,000**	**238,000**	**0**
2161	**CONTRACTUAL SERVICES (INCLUDING DATABASES)**													0
	A2.1 Quantifying N flows, threats and benefits at global and regional scales	36,000						36,000	22,000	10,000	2,000	2,000	36,000	0
	A2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstra		30,000				-	30,000	-	-	-	30,000	30,000	0
	A2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr			20,000			-	20,000	-	-	10,000	10,000	20,000	0
	A2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis				-			-	-	-	-	-	-	0
	A2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr.					10,000		10,000	2,000	4,000	2,000	2,000	10,000	0
	A2.0 Component level coordination						-	-	-	-	-	-	-	0
	Sub-total	**36,000**	**30,000**	**20,000**	**-**	**10,000**	**-**	**96,000**	**24,000**	**14,000**	**14,000**	**44,000**	**96,000**	**0**
2261	**GRANTS TO IMPLEMENTING PARTNERS**													0
	A2.1 Quantifying N flows, threats and benefits at global and regional scales	350,000						350,000	60,000	130,000	105,000	55,000	350,000	0
	A2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstra		200,000				-	200,000	10,000	80,000	110,000	-	200,000	0
	A2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr			160,000			-	160,000	30,000	45,000	65,000	20,000	160,000	0
	A2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis				135,000			135,000	65,000	40,000	25,000	5,000	135,000	0
	A2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr.					110,000		110,000	50,000	50,000	5,000	5,000	110,000	0
	A2.0 Component level coordination						110,000	110,000	28,000	27,000	27,000	28,000	110,000	0
	Sub-total	**350,000**	**200,000**	**160,000**	**135,000**	**110,000**	**110,000**	**1,065,000**	**243,000**	**372,000**	**337,000**	**113,000**	**1,065,000**	**0**
4161	**MATERIALS & SUPPLIES**													0
	A2.1 Quantifying N flows, threats and benefits at global and regional scales	4,000						4,000	2,000	2,000	-	-	4,000	0
	A2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstra		50,000				-	50,000	-	-	2,000	48,000	50,000	0
	A2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr			-			-	-	-	-	-	-	-	0
	A2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis				-			-	-	-	-	-	-	0
	A2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr.					2,000		2,000	1,000	1,000	-	-	2,000	0
	A2.0 Component level coordination						-	-	-	-	-	-	-	0
	Sub-total	**4,000**	**50,000**	**-**	**-**	**2,000**	**-**	**56,000**	**3,000**	**3,000**	**2,000**	**48,000**	**56,000**	**0**
4261	**NON EXPENDABLE EQUIPMENT (FURNITURE, EQUIPMENT)**													0
	A2.1 Quantifying N flows, threats and benefits at global and regional scales	-						-	-	-	-	-	-	0
	A2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstra		-				-	-	-	-	-	-	-	0
	A2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr			-			-	-	-	-	-	-	-	0
	A2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis				-			-	-	-	-	-	-	0
	A2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr.					-		-	-	-	-	-	-	0
	A2.0 Component level coordination						-	-	-	-	-	-	-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**

5161	**OTHER DIRECT OPERATING COSTS (TELECONFERENCE CALLS)**													0
	A2.1 Quantifying N flows, threats and benefits at global and regional scales	-						-	-	-	-	-	-	0
	A2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstra		-				-	-	-	-	-	-	-	0
	A2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr			-			-	-	-	-	-	-	-	0
	A2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis				-			-	-	-	-	-	-	0
	A2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr.					-		-	-	-	-	-	-	0
	A2.0 Component level coordination						-	-	-	-	-	-	-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
5581	**EVALUATION (CONSULTANTS FEES/TRAVEL/DSA/ADMIN SUPPORT)**													0
	A2.1 Quantifying N flows, threats and benefits at global and regional scales	-						-	-	-	-	-	-	0
	A2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstra		-				-	-	-	-	-	-	-	0
	A2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr			-			-	-	-	-	-	-	-	0
	A2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis				-			-	-	-	-	-	-	0
	A2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr.					-		-	-	-	-	-	-	0
	A2.0 Component level coordination						-	-	-	-	-	-	-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
	TOTAL COSTS	**480,000**	**500,000**	**260,000**	**180,000**	**140,000**	**120,000**	**1,680,000**	**390,000**	**516,000**	**475,000**	**299,000**	**1,680,000**	**0**

COMPONENT 3. RECONCILIATION BETWEEN GEF ACTIVITY BASED BUDGET AND UNEP BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project No:
Project Name: Towards the Intarnational Nitrogen Management System
Executing Agency: NERC Centre for Ecology & Hydrology

Source of funding: GEF

		COMPONENT 3. BUDGET ALLOCATION BY ACTIVITY						ALLOCATION BY CALENDAR YEAR					Check
		A3.1	A3.2	A3.3	A3.4	A3.0	Total	Year 1	Year 2	Year 3	Year 4	Total	
	UNEP BUDGET LINE/OBJECT OF EXPENDITURE	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	
1161	STAFF & OTHER PERSONNEL												
	A3.1 Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N	-					-	-	-	-	-	-	0
	A3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits		80,000				80,000	-	10,000	60,000	10,000	80,000	0
	A3.3 Building consensus on benchmarking N indicators for different regions and systems			5,000			5,000	-	2,000	3,000	-	5,000	0
	A3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.				50,000		50,000	-	-	-	50,000	50,000	0
	A3.0 Component level coordination					-	-	-	-	-	-	-	0
	Sub-total	**-**	**80,000**	**5,000**	**50,000**	**-**	**135,000**	**-**	**12,000**	**63,000**	**60,000**	**135,000**	**0**
1561	TRAVEL												0
	A3.1 Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N	-					-	-	-	-	-	-	0
	A3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits		50,000				50,000	-	-	50,000	-	50,000	0
	A3.3 Building consensus on benchmarking N indicators for different regions and systems			35,000			35,000	-	15,000	20,000	-	35,000	0
	A3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.				-		-	-	-	-	-	-	0
	A3.0 Component level coordination					-	-	-	-	-	-	-	0
	Sub-total	**-**	**50,000**	**35,000**	**-**	**-**	**85,000**	**-**	**15,000**	**70,000**	**-**	**85,000**	**0**
2161	CONTRACTUAL SERVICES (INCLUDING DATABASES)												0
	A3.1 Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N	-					-	-	-	-	-	-	0
	A3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits		-				-	-	-	-	-	-	0
	A3.3 Building consensus on benchmarking N indicators for different regions and systems			-			-	-	-	-	-	-	0
	A3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.				-			-	-	-	-	-	0
	A3.0 Component level coordination					-		-	-	-	-	-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
2261	GRANTS TO IMPLEMENTING PARTNERS												0
	A3.1 Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N	1,350,000					1,350,000	325,000	325,000	350,000	350,000	1,350,000	0
	A3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits		-				-	-	-	-	-	-	0
	A3.3 Building consensus on benchmarking N indicators for different regions and systems			30,000			30,000	-	15,000	15,000	-	30,000	0
	A3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.				-		-	-	-	-	-	-	0
	A3.0 Component level coordination					50,000	50,000	10,000	15,000	15,000	10,000	50,000	0
	Sub-total	**1,350,000**	**-**	**30,000**	**-**	**50,000**	1,430,000	**335,000**	**355,000**	**380,000**	**360,000**	**1,430,000**	**0**
4161	MATERIALS & SUPPLIES												0
	A3.1 Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N	-					-					-	0
	A3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits		-				-					-	0
	A3.3 Building consensus on benchmarking N indicators for different regions and systems			-			-					-	0
	A3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.				-							-	0
	A3.0 Component level coordination					-						-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
4261	NON EXPENDABLE EQUIPMENT (FURNITURE, EQUIPMENT)												0
	A3.1 Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N	-					-					-	0
	A3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits		-				-					-	0
	A3.3 Building consensus on benchmarking N indicators for different regions and systems			-			-					-	0
	A3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.				-							-	0
	A3.0 Component level coordination					-						-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
5161	OTHER DIRECT OPERATING COSTS (TELECONFERENCE CALLS)												0
	A3.1 Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N	-					-					-	0
	A3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits		-				-					-	0
	A3.3 Building consensus on benchmarking N indicators for different regions and systems			-			-					-	0
	A3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.				-							-	0
	A3.0 Component level coordination					-						-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
5581	EVALUATION (CONSULTANTS FEES/TRAVEL/DSA/ADMIN SUPPORT)												0
	A3.1 Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N	-					-					-	0
	A3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits		-				-					-	0
	A3.3 Building consensus on benchmarking N indicators for different regions and systems			-			-					-	0
	A3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.				-							-	0

	A3.0 Component level coordination					-						-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
	TOTAL COSTS	**1,350,000**	**130,000**	**70,000**	**50,000**	**50,000**	**1,650,000**	**335,000**	**382,000**	**513,000**	**420,000**	**1,650,000**	**-**

COMPONENT 4. RECONCILIATION BETWEEN GEF ACTIVITY BASED BUDGET AND UNEP BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project No:

COMPONENT 4. RECONCILIATION BETWEEN GEF ACTIVITY BASED BUDGET AND UNEP BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project Name: Towards the Intarnational Nitrogen Management System
Executing Agency: NERC Centre for Ecology & Hydrology

Source of funding: GEF

		COMPONENT 4. BUDGET ALLOCATION BY ACTIVITY							ALLOCATION BY CALENDAR YEAR					Check
		A4.1	A4.2	A4.3-4.4	A4.5	A4.6-4.9	A4.0	Total	Year 1	Year 2	Year 3	Year 4	Total	
UNEP BUDGET LINE/OBJECT OF EXPENDITURE		US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$	
1161	**STAFF & OTHER PERSONNEL**													
	A4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement	200,000						200,000	70,000	50,000	50,000	30,000	200,000	0
	A4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting		30,000					30,000	5,000	5,000	10,000	10,000	30,000	0
	A4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & developmnt of long-term strategy			140,000				140,000	40,000	30,000	30,000	40,000	140,000	0
	A4.5 Harmonization, publication & dissemination of guidance documents across components				10,000			10,000	2,000	2,000	3,000	3,000	10,000	0
	A4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP					75,000		75,000	18,000	19,000	19,000	19,000	75,000	0
	A4.0 Component level coordination						40,000	40,000	10,000	10,000	10,000	10,000	40,000	0
	Sub-total	**200,000**	**30,000**	**140,000**	**10,000**	**75,000**	**40,000**	**495,000**	**145,000**	**116,000**	**122,000**	**112,000**	**495,000**	**0**
1561	**TRAVEL**													0
	A4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement	10,000						10,000	3,000	2,000	2,000	3,000	10,000	0
	A4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting		25,000					25,000	4,000	6,000	7,000	8,000	25,000	0
	A4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & developmnt of long-term strategy			35,000				35,000	5,000	10,000	10,000	10,000	35,000	0
	A4.5 Harmonization, publication & dissemination of guidance documents across components				-			-					-	0
	A4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP					10,000		10,000	-	5,000	-	5,000	10,000	0
	A4.0 Component level coordination						-	-					-	0
	Sub-total	**10,000**	**25,000**	**35,000**	**-**	**10,000**	**-**	**80,000**	**12,000**	**23,000**	**19,000**	**26,000**	**80,000**	**0**
2161	**CONTRACTUAL SERVICES (INCLUDING DATABASES)**													0
	A4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement	20,000						20,000	5,000	5,000	5,000	5,000	20,000	0
	A4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting		-					-	-	-	-	-	-	0
	A4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & developmnt of long-term strategy			-				-	-	-	-	-	-	0
	A4.5 Harmonization, publication & dissemination of guidance documents across components				-			-	-	-	-	-	-	0
	A4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP					60,000		60,000	10,000	20,000	10,000	20,000	60,000	0
	A4.0 Component level coordination						-	-	-	-	-	-	-	0
	Sub-total	**20,000**	**-**	**-**	**-**	**60,000**	**-**	**80,000**	**15,000**	**25,000**	**15,000**	**25,000**	**80,000**	**0**
2261	**GRANTS TO IMPLEMENTING PARTNERS**													0
	A4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement	-						-	-	-	-	-	-	0
	A4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting		110,000					110,000	53,000	24,000	19,000	14,000	110,000	0
	A4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & developmnt of long-term strategy			-				-	-	-	-	-	-	0
	A4.5 Harmonization, publication & dissemination of guidance documents across components				-			-	-	-	-	-	-	0
	A4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP					-		-	-	-	-	-	-	0
	A4.0 Component level coordination						40,000	40,000	10,000	10,000	10,000	10,000	40,000	0
	Sub-total	**-**	**110,000**	**-**	**-**	**-**	**40,000**	**150,000**	**63,000**	**34,000**	**29,000**	**24,000**	**150,000**	**0**
4161	**MATERIALS & SUPPLIES**													0
	A4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement	20,000						20,000	5,000	5,000	5,000	5,000	20,000	0
	A4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting		-					-	-	-	-	-	-	0
	A4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & developmnt of long-term strategy			-				-	-	-	-	-	-	0
	A4.5 Harmonization, publication & dissemination of guidance documents across components				50,000			50,000	10,000	10,000	15,000	15,000	50,000	0
	A4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP					-		-	-	-	-	-	-	0
	A4.0 Component level coordination						-	-	-	-	-	-	-	0
	Sub-total	**20,000**	**-**	**-**	**50,000**	**-**	**-**	**70,000**	**15,000**	**15,000**	**20,000**	**20,000**	**70,000**	**0**
4261	**NON EXPENDABLE EQUIPMENT (FURNITURE, EQUIPMENT)**													0
	A4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement	-						-	-	-	-	-	-	0
	A4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting		-					-	-	-	-	-	-	0
	A4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & developmnt of long-term strategy			-				-	-	-	-	-	-	0
	A4.5 Harmonization, publication & dissemination of guidance documents across components				-				-	-	-	-	-	0
	A4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP					-			-	-	-	-	-	0
	A4.0 Component level coordination						-		-	-	-	-	-	0
	Sub-total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
5161	**OTHER DIRECT OPERATING COSTS (TELECONFERENCE CALLS)**													0
	A4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement	-					-	-	-	-	-	-	-	0
	A4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting		-					-	-	-	-	-	-	0
	A4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & developmnt of long-term strategy			-				-	-	-	-	-	-	0
	A4.5 Harmonization, publication & dissemination of guidance documents across components				-			-	-	-	-	-	-	0
	A4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP					55,000		55,000	55,000	-	-	-	55,000	0

	A4.0 Component level coordination							-	-	-	-	-	-	0
	Sub-total	**-**	**-**	**-**	**-**	**55,000**	**-**	**55,000**	**55,000**	**-**	**-**	**-**	**55,000**	**0**
5581	**EVALUATION (CONSULTANTS FEES/TRAVEL/DSA/ADMIN SUPPORT)**													0
	A4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement	-						-	-	-	-	-	-	0
	A4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting		-					-	-	-	-	-	-	0
	A4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & developmnt of long-term strategy			-				-	-	-	-	-	-	0
	A4.5 Harmonization, publication & dissemination of guidance documents across components				-			-	-	-	-	-	-	0
	A4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP					50,000		50,000	-	20,000	-	30,000	50,000	0
	A4.0 Component level coordination						-	-	-	-	-	-	-	0
	Sub-total	**-**	**-**	**-**	**-**	**50,000**	**-**	**50,000**	**-**	**20,000**	**-**	**30,000**	**50,000**	**0**
	TOTAL COSTS	**250,000**	**165,000**	**175,000**	**60,000**	**250,000**	**80,000**	**980,000**	**305,000**	**233,000**	**205,000**	**237,000**	**980,000**	**0**

East Asia Demonstration Area (3.1a). BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project No:
Project Name: Towards the Intarnational Nitrogen Management System
Executing Agency: NERC Centre for Ecology & Hydrology

Source of funding: GEF

			ALLOCATION BY CALENDAR YEAR				
		Total	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
UNEP BUDGET LINE/OBJECT OF EXPENDITURE		US$	US$	US$	US$	US$	US$
1161	STAFF & OTHER PERSONNEL						0
1561	TRAVEL						0
2161	CONTRACTUAL SERVICES (INCLUDING DATABASES)						0
2261	GRANTS TO IMPLEMENTING PARTNERS	270,000	65,000	65,000	70,000	70,000	270000
4161	MATERIALS & SUPPLIES						0
4261	NON EXPENDABLE EQUIPMENT (FURNITURE, EQUIPMENT)						0
5161	OTHER DIRECT OPERATING COSTS (TELECONFERENCE CALLS)						0
5581	EVALUATION (CONSULTANTS FEES/TRAVEL/DSA/ADMIN SUPPORT)						0
	TOTAL COSTS	**270,000**	**65,000**	**65,000**	**70,000**	**70,000**	**270,000**

South Asia Demonstration Area (3.1b). BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project No:
Project Name: Towards the Intarnational Nitrogen Management System
Executing Agency: NERC Centre for Ecology & Hydrology

Source of funding: GEF

			ALLOCATION BY CALENDAR YEAR				
		Total	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
UNEP BUDGET LINE/OBJECT OF EXPENDITURE		US$	US$	US$	US$	US$	US$
1161	STAFF & OTHER PERSONNEL						0
1561	TRAVEL						0
2161	CONTRACTUAL SERVICES (INCLUDING DATABASES)						0
2261	GRANTS TO IMPLEMENTING PARTNERS	270,000	65,000	65,000	70,000	70,000	270000
4161	MATERIALS & SUPPLIES						0
4261	NON EXPENDABLE EQUIPMENT (FURNITURE, EQUIPMENT)						0
5161	OTHER DIRECT OPERATING COSTS (TELECONFERENCE CALLS)						0
5581	EVALUATION (CONSULTANTS FEES/TRAVEL/DSA/ADMIN SUPPORT)						0
	TOTAL COSTS	**270,000**	**65,000**	**65,000**	**70,000**	**70,000**	**270,000**

Latin America Demonstration Area (3.1c). BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project No:
Project Name: Towards the Intarnational Nitrogen Management System
Executing Agency: NERC Centre for Ecology & Hydrology

Source of funding: GEF

			ALLOCATION BY CALENDAR YEAR				
		Total	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
UNEP BUDGET LINE/OBJECT OF EXPENDITURE		US$	US$	US$	US$	US$	US$
1161	STAFF & OTHER PERSONNEL						0
1561	TRAVEL						0
2161	CONTRACTUAL SERVICES (INCLUDING DATABASES)						0
2261	GRANTS TO IMPLEMENTING PARTNERS	270,000	65,000	65,000	70,000	70,000	270000
4161	MATERIALS & SUPPLIES						0
4261	NON EXPENDABLE EQUIPMENT (FURNITURE, EQUIPMENT)						0
5161	OTHER DIRECT OPERATING COSTS (TELECONFERENCE CALLS)						0
5581	EVALUATION (CONSULTANTS FEES/TRAVEL/DSA/ADMIN SUPPORT)						0
	TOTAL COSTS	**270,000**	**65,000**	**65,000**	**70,000**	**70,000**	**270,000**

East Africa Demonstration Area (3.1d). BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project No:
Project Name: Towards the Intarnational Nitrogen Management System
Executing Agency: NERC Centre for Ecology & Hydrology

Source of funding: GEF

			ALLOCATION BY CALENDAR YEAR				
		Total	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
UNEP BUDGET LINE/OBJECT OF EXPENDITURE		US$	US$	US$	US$	US$	US$
1161	STAFF & OTHER PERSONNEL						0
1561	TRAVEL						0
2161	CONTRACTUAL SERVICES (INCLUDING DATABASES)						0
2261	GRANTS TO IMPLEMENTING PARTNERS	270,000	65,000	65,000	70,000	70,000	270000
4161	MATERIALS & SUPPLIES						0
4261	NON EXPENDABLE EQUIPMENT (FURNITURE, EQUIPMENT)						0
5161	OTHER DIRECT OPERATING COSTS (TELECONFERENCE CALLS)						0
5581	EVALUATION (CONSULTANTS FEES/TRAVEL/DSA/ADMIN SUPPORT)						0
	TOTAL COSTS	**270,000**	**65,000**	**65,000**	**70,000**	**70,000**	**270,000**

East Europe Demonstration Area (3.1e). BUDGET BY EXPENDITURE CODE (GEF FINANCE ONLY)

Project No:
Project Name: Towards the Intarnational Nitrogen Management System
Executing Agency: NERC Centre for Ecology & Hydrology

Source of funding: GEF

			ALLOCATION BY CALENDAR YEAR				
		Total	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
UNEP BUDGET LINE/OBJECT OF EXPENDITURE		US$	US$	US$	US$	US$	US$
1161	STAFF & OTHER PERSONNEL						0
1561	TRAVEL						0
2161	CONTRACTUAL SERVICES (INCLUDING DATABASES)						0
2261	GRANTS TO IMPLEMENTING PARTNERS	270,000	65,000	65,000	70,000	70,000	270000
4161	MATERIALS & SUPPLIES						0
4261	NON EXPENDABLE EQUIPMENT (FURNITURE, EQUIPMENT)						0
5161	OTHER DIRECT OPERATING COSTS (TELECONFERENCE CALLS)						0
5581	EVALUATION (CONSULTANTS FEES/TRAVEL/DSA/ADMIN SUPPORT)						0
	TOTAL COSTS	**270,000**	**65,000**	**65,000**	**70,000**	**70,000**	**270,000**

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Appendix 03

Incremental Cost Analysis

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1 Rationale

The acceleration of the global nitrogen cycle by societal activities has brought both great benefits to humanity, in the form of increased food production and more food security, and great damage to environmental quality and human health (Galloway et al. 2008). Human activities have created five times more available reactive nitrogen through agriculture, industrial activities, and energy generation than all natural sources combined (Galloway et al. 2014). Excess reactive nitrogen now pervades the atmosphere, estuaries and oceans, soils, vegetation and freshwaters nearly throughout the globe, with increasing adverse impacts. 'Towards INMS' addresses a joined up approach to the global nitrogen cycle, particular relevance to water quality in rivers, eastuarine and coastal marine ecosystems, with a focus on nitrogen pollution, recognizing the multiple, simultaneous global changes. The overarching challenge for INMS is to provide governments and other societal actors the scientific evidence needed to support policy development for international nitrogen management that can improve the balance between, on the one hand, economic development and improved welfare and, on the other hand, protecting environmental health and biodiversity and climate stability.

Current perspectives for intervention in the nitrogen cycle vary greatly between world regions because of differences in the level of food and energy security in relation to nitrogen, and because of differences in nitrogen impacts. Further, perspectives will change in the future, because of increasing population, economic growth, welfare, resource scarcity and climate change. Currently, in regions with food and energy insecurity, policy makers must give priority to solving nitrogen deficiencies in agriculture. But without adequate education and incentives to minimize adverse impacts of increased food and energy production, there will be large effects of nitrogen on the environment.

Education and incentives based on scientific evidence are also important for helping developed regions manage their nitrogen use. Experiences in the European Union, and more recently in China, have shown that informing governments and the public about the societal costs of air and water pollution as caused by nitrogen compounds can catalyze policies and interventions to reduce emissions. But pollution is an externality, and as with any external costs that have not been regulated before, there will be countervailing industrial or agricultural forces reluctant to add costs of pollution abatement or prevention to the costs of producing goods and services. Cost benefit assessments can bridge the gap between environmental and human health protection, and economic development. Cost benefit assessments can also help to reveal inequities in who pays the costs for development or abatement, and if conducted with a systems approach, can help exploring unexpected consequences. For example, because agriculture, together with municipal wastewater, is a major source of nitrogen for national and international waters, abatement costs may fall disproportionately on farmers and may affect food production, prices, and food security locally, regionally, and globally. Identifying such types of repercussions of mitigation strategies may lead to different solutions that consider fair pricing of pollution control and yet be beneficial for water quality, air quality, greenhouse gas emission reduction etc.

The 'Towards INMS' proposal has a four-part approach to assist governments and societal actors in improving the balance between benefits and costs of interventions in the nitrogen cycle, using local scientific communities as intermediaries:

- Component One: Tools and methods for understanding the nitrogen cycle
- Component Two: Global & regional quantification of nitrogen use, flows, impacts & benefits of practices

- Component Three: Regional demonstration & verification (building on planned and existing interventions)
- Component Four: Awareness raising & knowledge sharing

2 Cost benefit Analysis in INMS and use for policy support

In 'Towards INMS', cost and benefits of interventions in the nitrogen cycle will be identified for the classic environmental issues (Water-Air-Greenhouse-Ecosystems-Soil; WAGES), and provision of Food security (F) and Energy security (E) as related to nitrogen; hereafter summarized as WAGES-FE. INMS takes an integrated approach to the entire nitrogen cascade by considering all potentially relevant positive or negative impacts of intervention.

INMS takes a four-tier approach to impact assessment and cost benefit analysis, the results of which all can support decisions to intervene in the nitrogen cycle.

Tier 1: Metrics that quantify environmental emissions, such as water quality per unit area.

Tier 2: Impacts of nitrogen pollution on health and environment by sector, such as the incidence of respiratory illness, cancers, frequency and extent of harmful algal blooms, or effects on biodiversity or forest vitality.

Tier 3: Impacts expressed as how far or how near interventions get toward achieving internationally or nationally agreed policy objectives.

Tier 4: Impacts expressed in common units that are relevant for society, such as life expectancy or ecosystem services. Ultimately impacts are expressed as welfare loss or gain in monetary units.

Multiple studies have addressed Tiers 1 and 2. Fewer studies have addressed Tier 3 and studies focusing on Tier 4 are even-more scarce. Tier 4 quantifies costs and benefits related to the effects of use of nitrogen fertilizers and nitrogen emissions related to human activities. Tier 3 and 4 results are more directly useful for policy support, but must be accompanied by robust uncertainty analysis due to the many considerations involved with interactive effects of nitrogen management.

The European Nitrogen Assessment produced an integrated estimate of costs and benefits related to nitrogen in the EU in 2011, expressed in monetary units. An important conclusion was that the total external cost of current nitrogen use in EU agriculture is similar to the total value of agriculture for the EU economy. Human health hazard caused by ammonia emissions and ecosystem degradation from nitrogen runoff were the two dominant costs. These results justify current EU environmental policies and support proposals for stricter policies. However, there is a fundamental problem in implementing these policies as in the current institutional setting farmers bear the costs of nitrogen mitigation while the general public receives the environmental benefits. Cost-benefit results show that for the EU better management in nitrogen intensive regions generates benefits, without affecting food or energy security, but there are many political and socio-economic barriers for these directions of solutions to become policy or practice. Cost-benefit results can open a dialogue about redesigning agriculture to increase the net benefits, while maintaining food security and adequate farm income.

3 Business as Usual Scenarios

Currently the intentional and unintentional release of nitrogen to the environment has dramatically altered the global nitrogen cycle. In addition to emissions to the atmosphere and inputs to soils, surface and groundwater, there has been a large increase in nitrogen flows in rivers and submarine groundwater discharge to coastal waters through much of the world (Beusen et al. 2013). Approximately 20% of nitrogen release comes from fossil fuel use, with the remainder from agriculture. But the efficiency of nitrogen use in food production is low: on average more than 80% of the nitrogen applied to fields is lost to the environment (Sutton et al., 2013). This inefficiency is compounded by an increasing demand for meat and dairy products commensurate with growing economic security in many countries. Crops are increasingly fed to livestock, especially monogastrics, to satisfy this increasing demand. About 30% of the global arable land is currently used to produce animal feed, with a comparable amount of nitrogen fertilizer application. The crop-livestock production system is the single largest cause of human alteration of the global nitrogen cycle (Bouwman et al. 2013). A Business as Usual (BAU) scenario assumes a world in 2050 with increasing human population, increased economic growth, increasing per-capita consumption of meat and dairy (Bouwman et al. 2013). This scenario causes increased releases of nitrogen to the environment and increased adverse impacts. There are important regional differences, however. Industrialized countries are expected to become more efficient in their use and recovery of nitrogen while developing countries will increase agricultural productivity but at the cost of reduced nutrient use efficiency and increased losses to the environment.

Table A3.1: *Recent estimates of external costs in world regions due to nitrogen pollution.*

	Human Health	**Ecosystems**	**Total**
EU – 2008; All sources (Grinsven et al., 2013)	40-170 bio €$^{-1}$ yr^{-1}	70-300 bio €$^{-1}$ yr^{-1}	110-470 bio €$^{-1}$ yr^{-1}
EU – 2008 Agricultural sources	10-70 bio €$^{-1}$ yr^{-1}	35-155 bio €$^{-1}$ yr^{-1}	35-225 bio €$^{-1}$ yr^{-1}
US - 2008; All sources Sobota et al 2015			81-441 bio \$$^{-1}$ yr^{-1}
US -2008; Agricultural sources			59-340 bio \$$^{-1}$ yr^{-1}
China-2008 Gu et al, 2012	19-62 bio \$$^{-1}$ yr^{-1}		
World; all sources Sutton et al., 2013			300-3000 bio €$^{-1}$ yr^{-1}

Under the BAU scenario damage to surface, ground and coastal waters will worsen, leading to increased occurrences of harmful algal blooms, hypoxia or dead zones, loss of fisheries and increased human health impacts. 'Towards INMS' will quantify the cost benefit effects of alternative food and energy scenarios on regional and global nitrogen cycles with the intention of informing future nitrogen policy development. Both concepts and empirical data for current cost-benefit assessments can and will be improved through 'Towards INMS'.

4 The Cost Increment of INMS for GEF

The integrated nitrogen assessment approach in 'Towards INMS', combined with nitrogen cost benefit assessment, provides consistent information about current impacts of food and energy production and consumption on the aquatic environment. By also expressing impacts in the universal language of loss or gain of ecosystem services and loss or gain of welfare (in economic or human health units), information will help to improve the debate and cooperation between states or between economic sectors for collective management of large water systems while providing benefits for environment, food production, economic development, community health, and regional stability (source GEF-5 IW strategy, 2011). It may stimulate identification of transboundary solutions, interventions and investments, particularly for related to improved nitrogen management in agriculture and treatment and recycling of nitrogen in wastewater.

Comparison of cost and benefits of current nitrogen use and emissions, for BAU projections and for various abatement scenario's (like the recently developed Shared Socio-economic Pathways, SSPs), will further support identification of transboundary and trans-sector solutions for improved water quality while maintaining food security, a viable agricultural sector with improved nitrogen resource efficiency. 'Towards INMS' thus will help GEF to remove current barriers between the agricultural sector and the public water sector to find comprehensive and socio-economically inclusive solutions that prevent a further degradation of water and agricultural systems around the globe and instead direct human activities and institutions toward sustaining multiple uses of the soil and water resource. This will be one of the building blocks for the GEF goal to implement a range of policy, legal, and institutional reforms and investments contributing to sustainable use and maintenance of ecosystem services.

Impact assessments and cost-benefit results for the EU and the US show that there is large potential to increase the net societal benefit of nitrogen use and management in agriculture, the energy sector and wastewater. There is an equally large potential for developing economies to learn from current and past experiences in Europe and the US and produce sufficient food and energy with less nitrogen pollution. The setup of 'Towards INMS', with regional demonstration projects and dedicated activities to raise awareness and share knowledge with regional communities of scientists and practitioners will support foundational capacity building, portfolio learning, and targeted research needs.

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Appendix 04

Project Results Framework

Background

The following tables outline the project results framework at Objective level, and then Outcome and Output level by Component. A list of acronyms is given at the end of the document.

Project Objective

Project Objective	Indicators	Baseline	Target	Sources of Verification	Assumptions
To improve the understanding of the global/region N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems	National / regional / global bodies developing new policies based on the INMS approach to manage N_r [P] Number of stakeholder groups (including private sector, such as fertiliser and food related industries) supporting / endorsing INMS methodology and using tools to inform internal policies [P] Number of civil society groups acknowledging the need for an INMS approach to managing N_r [P]	Initial work on policy homes for nitrogen.	• 5 countries using INMS approach • 3 policy processes incorporate INMS approaches • International endorsement of the need to address the nitrogen issue and the effectiveness of an INMS approach (e.g. UNEA) (Yr 4) • GPA & others promotes the results of the work on 'Policy homes for nitrogen' (Yr 2) and the effectiveness of the INMS approach in addressing nitrogen issues (Yr 3) • 3 stakeholder groups endorse INMS approach and consider how its applies to their activities • Launch of a global assessment promoting the INMS approach to stakeholders, civil society and the public, with associated engagement products and strategies such as the Nitrogen Champions (15), to further engage and disseminate Key INMS messages and concepts	• Reports and minutes from country level meetings and policy bodies. • Reports from UNEA meetings • Reports from GPA • Global assessment publication and launch materials • Engagement products and information in web portal	Buy-in from policy, government and industry stakeholders and the public Adequate communication between science assessments, policy development and stakeholders

NOTE: Specific mid-term and project targets are included in the component appendices (Appendices 15-18), [P] – Process Indicator; [SR] – Stress Reduction Indicator; [ES] – Ecosystem and Socio-Economic Indicator

Component 1: Tools to apply methods for understanding Nitrogen Cycle

Outcomes and Outputs	Indicator	Baseline	Target	Sources of Verification	Assumptions
Outcome 1: Stakeholders, including policy makers, scientists, industry, farmers, business and civil society, have an agreed basis for informed decision making on N cycle management	Number of stakeholder groups using INMS tools and endorsing INMS procedures as a means to manage too much and too little N [P]	A fragmented approach in science input between different parts of the nitrogen cycle. Activities starting to join up N cycle at regional scale (e.g. TFRN, OECD), but not globally.	At least five user groups identifying INMS in their management actions International/regional bodies endorse use of tools (e.g. GPA, LRTAP, OECD, CBD, FAO, WMO)	• Published information • Working documents of international/ regional bodies	Buy-in from stakeholder to the INMS system Adequate communication between science assessments and policy development
Outcome 2: Stakeholders using agreed assessment and quantification methods to evaluate N cycle status acting as a common basis for regional / global scenarios to guide management actions.	Management actions in pilot areas (and more widely) using tools developed by INMS to inform decision making [P]	Lack of agreed assessment and quantification methods to support management of the nitrogen cycle. Preliminary basis on N effect and system indicators, but lacking coherence.	At least five stakeholder groups using tools developed by INMS to inform decision making International/regional bodies endorse use of methodologies	• Published information • Working documents of international / regional bodies	Adequate communication between science assessments and policy development Willingness to utilize approaches for developing strategies for N management
Output 1.1: Development of Indicators for assessing full N budgets, use, levels and impacts, including N use efficiency and benchmarking. Indicators would be developed of relevance for specific stakeholders	Guidance documents for specific applications and stakeholders published on web portal [P]	Guidance on N budgets and NUE from UNECE, OECD, ONW, EU-NEP, GPNM with a need to harmonize & understand variants	Completion /Acceptance of Guidance Documents for: • National N budgets (Yr 4) • Farm N budgets (Yr 3) • NUE methodology (Yr 3) • Relating level and effect to N budget indicators (Yr 4)	• PPA & PMB minutes • Project reports • Project website	Consensus on common global approaches for indicators achieved
Output 1.2: Methodology for threat assessment	Reports on work on methodologies published on web portal [P]	No methodology for regional / global threat assessments for N_r	Completion/acceptance of key reports: • Report on N threats and criteria (Yr 1) • Response from stakeholders on threats and criteria (Yr 1) • Workshop report on N threat assessment methodology (Yr 2) • Guidance on integrated N threat assessment methodology (Yr 3)	• PPA & PMB minutes • Project reports • Project website	Consensus on common regional/global approaches for threat assessment achieved
Output 1.3: Methods for determining N fluxes and distribution (water, air, land, agriculture, industry, etc.)	N flux methods & reports published on web portal [P]	Fragmented methodologies for different parts of the nitrogen cycle and for different regions. No joined up synthesis available.	Targeted reports on: • N fluxes & distribution (Yr 1) • Background document (to support workshop) on N fluxes and distribution (Yr 2) • Workshop report on N fluxes and distribution (Yr 3) • Guidance document on fluxes and distribution methods (Yr 4)	• PPA & PMB minutes • Project reports • Project website	Consensus on common regional/global approaches for determining N fluxes and distribution achieved
Output 1.4: Approaches to estimate the value of N threats and benefits	Valuing threats and benefits, methods & reports published on web portal [P]	Cost-benefit analysis for nitrogen so far conducted only for Europe, USA and China, with a need to harmonize approaches and agree common principles to allow wider application	Targeted reports on: • N threats & benefit valuation, gaps & challenges (Yr 1) • Threat-benefit valuation for global/regional comparisons (Yr 2) • Methodology for integrating benefits & threats across food, health, ecosystem, climate etc. (Yr 3) • Valuation of benefits & threats under future scenarios (Yr 4)	• PPA & PMB minutes • Project reports • Project website	Access to necessary data within timeframe of the project
Output 1.5: Approach to using existing N flux/pathway models for regional assessments and visualisation for potential scenarios to assist with development and reduction strategies.	Methods, database and reports in relation to models and scenarios, published on web portal [P]	Existing modelling of nitrogen cycle mainly fragmented into different issues. There is a need to link up between N forms, N effects and from biophysical to economic modelling in order to highlight the co-benefits of better nitrogen management.	Targeted reports including: • Database on models, data needs, information flows, etc. • Criteria for N modelling to address management options and scenarios (Yr 1) • Application of selected N models as a cluster (Yr 3) • N flux/pathway modelling demonstrated for global/regional scenarios (Yr 3) • Key outcomes from model runs uploaded to database	• PPA & PMB minutes • Project reports • Project website	Consensus on cluster of suitable models achieved Linkages of suitable models can technically be achieved on a useable timescale
Output 1.6: Understanding the barriers to change at all levels of society (government, private sector and civil society) including technical, financial and socio-political limitations.	Reports on barriers to change published on web portal [P]	Until now there has been little strategic analysis of the barriers to better nitrogen management. ENA and ONW highlight role of stakeholder complexity and need to find nexus points.	Targeted reports including: • Examination of economic, cultural & other factors impacting adoption of N management options (Yr 1) • Examination on global/regional N barriers to change in the food system and in consumption/production (Yr 3) • Options to overcome barriers to inform global approach and regional demos. (Yr 4)	PPA & PMB minutes • Project reports • Project website	Access to necessary data within timeframe of the project, across relevant levels of society

Component 2: Regional / global quantification of N use, flows, impacts and the quantitative benefits of applying best management practices

Outcomes and Outputs	Indicator	Baseline	Target	Sources of Verification	Assumptions
Outcome 3: Regional and Global information on N cycle fluxes and impacts, enabling strategies to be implemented to minimise negative effects of excess or insufficient reactive N, while maximising the quantified co-benefits for other sectors including the Green Economy	Number of new strategies at national, regional or global level to mitigate excess or insufficient N_r using information from INMS [P/SR]	Current policies based on fragmented approach and facing major barriers to change. No coordinated source of information on the global nitrogen cycle for application in policies	Progress towards at least 10 countries using INMS approaches and information to support their national policies 5 countries working on developing integrated nitrogen strategies using INMS resources	• National plans and documentation • Documentation shared through multilateral environmental agreements	National buy-in to INMS process Adequate communication between science assessments and policy development
Output 2.1: Quantification & assessment of the regional threats from excess N and insufficient N	Data and reports to support regional demonstrations [P]	Lack of agreement on approaches. Lack of globally coherent picture across the nitrogen cycle and its multiple impacts.	• Support to regional demos with inventory expertise and models (Yr 2) • Demonstrated comparison of current situation and future scenarios for N threats and benefits • Regional/global approaches incorporated into high profile global assessment (Yr 4)	• High visibility global assessment delivered. • Guidance documentation on N management delivered • Costs benefit analysis delivered • Modelling results reported for present and future conditions • Independent documentation shows take up of results	Data availability in regions and possibility to source necessary data within project timeframe Timely delivery of work from regional demonstrations for inclusion in global assessment
Output 2.2: Detailed overview of regional/local N flux and consolidation into a global assessment of N fluxes and pathways	Completion of regional assessments of N fluxes, including impacts and lessons from demos [P]	Some regional assessments existing, but not available for most regions.	• Agreed scope & outline of global assessment of N fluxes etc. (by end Yr 1) • Commissioned experts delivered high quality chapters passing peer review (Yr 4) • Review of chapters by SPAG, PPA and other stakeholders (Yr. 4) • Global assessment report published for wider public dissemination (Yr 4)	• Scoping document shared with partners and external review • Assessment chapters delivered for peer review • Modelling and scenario outcomes and delivered and reported • Body of evidence on success stories and challenges shared • 3 international policy processes using the results	Timely delivery of chapter drafts and reviews
Output 2.3: Consolidation of methods and good practices to address issues of excess and insufficient nitrogen	Specific reports published to support addressing excess and insufficient N [P]	Available guidance documentation only available for fragmented sets of issues, N forms and effects	• Background docs for workshop (Year 2) • Workshop (50 participants) methods for N management and mitigation (Yr 3) • Consolidated methods/practices report & database published (Yr 4)	• Documentation delivered • Users applying documentation as demonstrated by their own documentation	Willingness to share information on methods and include it within the INMS database
Output 2.4: Definition of programmes and policy options for improved Nr management at local/regional/global levels, supported by cost-benefit analysis to underpin options for the Green Economy.	Specific reports published on future N scenarios with mitigation options [P]	Current programmes have little awareness of the links between themselves and other parts of the nitrogen cycle. Fragmentation is a significant contributor to the barriers to change.	• Background docs for workshop (Yr 2) • Workshop (80 participants) on N policies and scenarios completed & reported (Yr 3) • Published report on N policy options & contribution to Green Economy (Yr 4)	• Documentation delivered • Users applying results as demonstrated by their own processes.	Consensus on relevant scenarios achieved Adequate communication between programmes
Output 2.5: Compendium summarizing the state of knowledge, experience and measures adopted by GEF (and others) gained from addressing the issues of excess and insufficient Nr	Published reports [P] Reports on key successes as well of failures and lessons learned distributed to stakeholder network. [P]	STAP report 2011 on eutrophication LRTAP assessment report Examples brought together through the GNC project Little awareness of bi-lateral programmes and successes by wider global community.	• Summary (inc. database) of GEF N management measures (Yr 1) • Summary (inc. database) of non-GEF N management measures (Yr 2) • Contributions to consolidated guidance feeding into Output 2.3	• Documentation delivered • Results incorporated into global assessment report, guidance document and INMS communication documentation	Access to necessary datasets/information to generate compendium possible

Component 3: Regional demonstration of Full Nitrogen Approach

Outcomes and Outputs[1]	Indicator	Baseline	Target	Sources of Verification	Assumptions
Outcome 4: GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised.	Consolidated global assessment produced, including regional nitrogen assessments [P] Synthesis of success stories and strategies to overcome barriers to change published on web portal [P]	Highly variable focus on nitrogen, separated in regional and national approaches between N form, source and impact,	Five regional nitrogen assessments completed by Year 4 and included in consolidated global assessment (A2.2).	Results published from INMS regional demonstrations	Regional and country buy-in to INMS process
		Little joined up effort and limited progress	Each regional demonstration identifies success stories and approaches to overcome barriers (by Yr 3)	Published results and working documents.	Inadequate communication between science assessments and policy development
	National and International bodies using INMS results [P/SR] Project-level demonstration methodology guidelines adopted and published [P]	Need to show how a joined up N approach can help and demonstrate this in international programs and conventions	GPA and regional intergovernmental and international programs making use of INMS outcomes in strategies (by Yr 4)	Working documents and publications of international bodies relevant for INMS regional demos.	Active participation of the populations and policy makers in 5 regions
	Requests for and application of demonstration area methodologies, tools and practice by external parties [P]	Limited information from previous GEF interventions and partial N budget recently developed.	Project level methodology developed and agreed.	Workshop reports	Availability of diversified expertise and technologies in 5 regions
			Uptake of demonstration area methodology in other areas.	Contribution to synthesis documents	Willingness of scientists and policymakers to take on INMS approach
Output 3.1: 3/4 regional/ national/local demonstration activities (that build on existing or planned nitrogen management actions providing catalytic results) deliver conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing: **Case 1:** Challenges and opportunities for developing areas with excess reactive nitrogen. **Case 2:** Challenges and opportunities for developing areas with insufficient reactive nitrogen. **Case 3:** Reactive nitrogen challenges and opportunities for regions with transition economies. **Case 4:** Challenges and opportunities for developed areas with excess reactive nitrogen (using co-financed resources only).	Report on N sources and N flows for each region. [P]	Lack of joined up data on N sources and flows regionally.	Quantified N flows, with uncertainty indication for 4 cases by end Year 3.	Reports, contribution to global synthesis (A2.2).	Insufficient data on N flows available (or able to be gathered), within project timeframe
	Report on consensus on N priority sources, forms and impacts for each region. [P]	Lack of knowledge on how N sources and impacts fit together.	Clearly identified priorities for N sources, forms and impacts for 5 regions by end Year 3	Reports of science-stakeholder workshops, summary reports.	Engagement between scientists and stakeholders at regional and national levels
	Regional condition according to agreed N performance indicators. [P]	Lack of knowledge on how different N indicators relate, especially at regional level.	Statement of regional performance in using internationally agreed N indicators for 5 regions by end Year 3.	Reports and publications, contribution to INMS- wide publications.	Adequate communication between science assessments and policy development
	Information on priority N management and mitigation options. [P]	Diversity of views and lack of consensus on the best methods to obtain N co-benefits.	Draft 'Top 10' priority measures for improved N management for each regional demo (end Yr 3).	Reports provided to A2.3 for incorporation in global comparison.	As above
	Information on successes and opportunities. [P]	Variable progress, with limited attention to linking N co-benefits	Document for each region, showing how N approach can address barriers and share success stories (Yr 4).	Regional Documents for each demonstration.	As above
	Information on regional specificities for global scenarios [P]	Existing global scenarios paying insufficient attention to regional conditions.	Global scenarios informed by evidence from regional demos (Yr 3).	Workshop reports. Report of A2.4 details regional aspects considered.	As above
	Field trials in regional demonstration activities show an improvement of 20% in Nitrogen Use Efficiency [SR]	Variable, dependant on field sites selected.	Field trials in 3 demonstration regions (Yr 4)	Reports from C3 Management Group	Known co-financing at selected demonstrations will allow field trials. Field trials in other demonstration areas will be subject to the availability of additional co-financing.

Outcomes and Outputs	Indicator	Baseline	Target	Sources of Verification	Assumptions
Output 3.2: Assessment and quantification of impacts from piloting activities to reducing negative impacts from poor N_r management, while demonstrating the co-benefits for other issues.	Extent of synthesis between the INMS regional demonstrations [P]	'Our Nutrient World'[2], Ch. 7. Preparatory meeting report.[3]	Workshop with 5+ regional demos and global partners (Yr 3) Workshop outcomes synthesized into consolidated global assessment (A2.2) (Yr 4)	Workshop report Chapter in global assessment Other publications.	Availability of results from demonstration regions
Output 3.3: Refined benchmarking of indicators for different regions and nutrient flow systems.	Agreement on benchmarking N indicators [P]	Progress already started in agreement of N indicators, such as from GPNM, EU-NEP, OECD, TFRN. Need to further refine benchmarking and relationship between efficiency and effect indicators.	Harmonized approach for reporting benchmarking (end Yr 2) Provisional proposals on benchmark values (end Yr 3) Finalization of benchmarking and identification future needs.	Working paper on N indicator benchmarking between regions Meeting and/or mission reports Section on benchmarking incorporated in to global synthesis and practice guidance (A2.2, A2.3).	Consensus on common global approaches for indicators achieved
Output 3.4: Plans for inclusion of agreed approach to N cycle assessments agreed in support of the emerging Policy Arena on Nitrogen in engagement with GPA, OECD, UNEA and other bodies.	Reports and documents which highlight discussion and inclusion of the N cycle approach being adopted by GPA and other bodies. [P]	N currently treated by policy programmes and conventions separated by form and impact type. Lack of joined up approach	Reports of presentations to GPA and other policy forums, using outcomes of regional demos. Documents of GPA and regional and global policy processes showing impact of N cycle approach including INMS results.	Meeting reports of GPA and other international processes Publications profiling the lessons from INMS regional demos for regional programmes.	Regional and intergovernmental buy-in to the INMS process Adequate communication between science assessments and policy development

[1] A project results framework has also been developed for the Component 3 Management strategy, which can be found in Appendix 17.

[2] Sutton M.A. et al. (2013) *Our Nutrient World: The challenge to produce more food and energy with less pollution.* Global Overview of Nutrient Management. CEH Edinburgh, on behalf of GPNM and INI. 114 pp.

[3] Brownlie W.J., Howard C.M., Pasda G., Navé B, Zerulla W. and Sutton M.A. (2015) Developing a global perspective on improving agricultural nitrogen use. *Environmental Development*. **15**, 145-151.

Component 4: Awareness raising and knowledge sharing

Outcomes and Outputs	Indicator	Baseline	Target	Sources of Verification	Assumptions
Outcome 5: Local , national and regional expertise to address N_r issues increased and contributes to improved decision making in the Policy Arena on Nitrogen at the regional / global levels	Number of experts established and trained [SR] Number of female experts receiving travel funds to attend meetings or having received training.	Contacts established in a number of intergovernmental processes and at country level, but no formal training or information has been provided.	• Network of 15 nitrogen champions initiated, including at country representative level • 30k travel funds utilised by female participants (from project wide travel budget)	• List of nitrogen champions • Minutes of intergovernmental processes, including GPA • Meeting reports.	Country, GPA and intergovernmental buy-in to the INMS process.
Outcome 6: Improved access to and sharing of information in co-operation with IW:LEARN	INMS information available on IW:LEARN and relevant links and information shared with GPNM for addition to their web portal [P/SR]	Some information available on GPA and GPNM web portal	• Nitrogen specific information available through links from IW Learn and on INMS web portal	• Web portal	Willingness of GEF IW portfolio projects to engage on nitrogen issues
Outcome 7: Improved knowledge management with compiled knowledge and experiences about the project shared with other GEF projects and GEF Sec. and accessible on IW:LEARN.	INMS information available on IW:LEARN with links to GPA and other interested bodies [P/DR] Databases available on web portal [P] GEF IW nutrient projects report utilising INMS methods [SR]	0	• 3 experience notes • INMS Databases established and populated • INMS web portal linked to IW:LEARN • 2 GEF IW nutrient projects trial INMS methods	• INMS Web portal • Links available on IW:LEARN • Reports from GEF IW projects trialling INMS methods	Support from INMS partners to source and supply/upload necessary data into databases Willingness of GEF IW portfolio projects to engage on nitrogen issues
Outcome 8: Improved project execution from IW Conference participation and the use of the GEF5 IW indicator tracking system	IW Conference participation [P]	0	• Launch of project at IWC8 • INMS initial results presented to IWC9 • INMS final results presented to IWC10	• Reports from IW Conference	Project start date prior to IWC8.
Output 4.1: Information sharing and networking portal to assist the GPA, OECD, UNEA, UNECE and other bodies with uptake of understanding of N_r cycle and means to mitigate negative impacts.	Project website establishment and population, and in-use by GPA (and other bodies [P]	0	• INMS web portal created (Yr 1) • 50 members of the project web portal (Yr2) • Information on project activities regularly updated • 8 Project newsletters (2 per Yr) • 4 Press releases (1 in Yr3, 4 in Yr4) • 4 engagement products (infographics/audio/video) (1 in Yr3, 3 in Yr4) • 4 Key Messages communicated (Yr 4) • Development of a network of 'N Champions' (5 = Yr 2, 15 = Yr4)	• Web portal available to view • Membership list of website • Newsletters posted on website • Press releases posted on web portal • Engagement products posted on website • List of N Champions	Willingness for INMS partners to engage with the project web portal Buy-in to INMS process by potential Nitrogen Champions
Output 4.2: Training for regional/national experts to sustain and enhance understanding of global N cycle implementation of national indicators, diffusion of new technologies and links across the nitrogen policy arena relevant for inter-governmental processes	Number of experts trained including via online/MOOCs [SR] Number of instances by countries & other intergovernmental process on N management [P] Number of regional N-footprint tools in development [P]	0 Good links with UNECE, OECD, GPA. N-Calculators in existence for selected countries.	• 1 training workshop aimed at strengthening N management (Yr 4) • 3 training items aimed at strengthening N management, including MOOC (1 = Yr 2, 3 = Yr 4) • INMS discussed at 3 intergovernmental meetings (1 = Yr 2, 3 = Yr 4) • INMS mentioned in 3 country level reports (1 = Yr 2, 3 = Yr 4) • 15 participants at a workshop on N footprinting (Yr 2)	• Report from training workshop • Training items available through website, including details on MOOC • Reports from intergovernmental meetings • Country level reports • N Footprinting workshop report	MOOC development co-financed by the activities of the NEWS India-UK Project Country, GPA and Intergovernmental buy-in to INMS concept, willingness to discuss at relevant meetings Suitable co-financing can be found to develop N Footrprinting tools in further countries

Outcomes and Outputs	Indicator	Baseline	Target	Sources of Verification	Assumptions
Output 4.3: Overall demonstration of the International Nitrogen Management System (INMS) in support of understanding the Global Nitrogen Cycle to further strengthen the objectives of GPA, UNEA, OECD, UNECE and other bodies across the emerging Policy Arena on Nitrogen.	Final publication & presentation of INMS approach on web portal and as part of the global assessment [P]	Materials developed in proposal stage, along with 'Initial Review of N Policy Homes' document.	• 5 Key Messages on INMS developed (Yr 4) • 5 publications (including Guidance documents under OP4.5) • 4 INMS Annual Meetings, with stakeholder engagement (1 per Yr) • 2 special workshops or side-events, at intergovernmental fora, such as UNEA, UNECE, OECD. (1 = Yr2, 2 = Yr 4) • INMS contributes to UNEA and IW conferences (Yrs 2 & 4)	• Key messages on website • Publications available • Reports from INMS meetings and stakeholder engagement • Reports from special workshops • Reports from UNEA and IW conferences	Consensus can be achieved on a core set of clear Key Messages Intergovernmental buy-in to INMS concept, willingness to jointly organise events with INMS
Output 4.4: Presentation of INMS development to UN Environment Assembly in Yrs 1 & 3	Number of staff attending UNEA meetings. [P]	0	Attendance at 2 UNEA meetings, presentation made on INMS or side-event organised. (Yrs 2 & 4)	• Reports from UNEA meetings	Availability of staff to attend (i.e. clashes with other meetings)
Output 4.5: Guidance documents specific to selected stakeholders advising on assessing and presenting nitrogen management and use efficiency issues	Published guidance documents [P]	Existing documents on National nitrogen budgets, ammonia mitigations measures (UNECE), European Nitrogen Assessment, North American Nitrogen Assessment, GNC Toolbox, NUE documentation from GPNM, EU-NEP, SDG process.	• Guidance documents on N budgets, indicators benchmarking and NUE published (Yr 4) • Guidance documents on N threats, fluxes and distribution published (Yr 4) • Guidance documents on N measures & good practices published (Yr 4)	• Publication of INMS specific guidance documents.	Support from INMS partners and wider community to both source comprehensive information on existing guidance and provide fit for purpose reviews of materials
Output 4.6: With 1% of the project resources in support of IW:LEARN:	Web portal creation [P]	0	• Web portal (Yr 1) • Online linkages made to GEF IW:LEARN (Yr 1) • Active participation in GEF IW Conferences 8&9	• Web portal • INMS project listed on IW learn	
Output 4.7: Dedicated project website connected with IW:LEARN and other GEF knowledge management systems (within 6 months).	Web portal established [P]		• Web portal connected to IW:LEARN (Yr 1)	• Web portal	
Output 4.8: Documented cooperation and knowledge exchange with (i) IW:LEARN including at least one functioning CoP as well as (ii) with STAP	Number of documents prepared for IWL [P] Number of exchanges with other GEF IW projects [P]	Actions of the GEF projects.	• Set up a Nitrogen management CoP using the INMS web portal (Yr 2) • Documented exchanges with 3 other GEF projects (Yr 4)	• CoP available to access on INMS web portal • E-mail communications, or reports	Willingness of GEF IW portfolio projects to engage on nitrogen issues
Output 4.9: Participation at the International Waters conferences; at least 3 experiences notes and tracked project progress reported using the GEF5 IW tracking tool.	Number of project related staff attending IWCs [P] Number of Experience Notes/other IWL publications [P]	0	• 3 GEF Experience Notes published (1 = Yr 2, 3 = Yr 4) • Attendance at IW Conferences (Yrs 2 & 4)	• Reports from IW Conferences • Experience notes posted onto the web portal • GEF IW Tracking Tool	Available of staff to attend (i.e. clashes). Willingness of GEF IW portfolio projects to engage on nitrogen issues

Acronyms

CBD	UN Convention on Biological Diversity
ENA	European Nitrogen Assessment
EU-NEP	European Union Nitrogen Expert Panel
FAO	UN Food and Agriculture Organisation
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities
GPNM	Global Partnership on Nutrient Management
INI	International Nitrogen Initiative
LRTAP	UNECE Convention on Long-range Transboundary Air Pollution
NUE	Nitrogen Use Efficiency
OECD	Organisation for Economic Cooperation and Development
ONW	Our Nutrient World
PMB	Project Management Board
PPA	Project Partners Assembly (all INMS partners)
UNECE	United Nations Economic Commission for Europe
WMO	World Meteorological Organisation

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 05

Work Plan and Timeline

Table of Contents

1 Background

A Work Plan has been devised for each Task, including key milestones for meetings (M), workshops (W), reports (R) and project web portal (I). Work Plans for each Component are shown below, 'Key Deliverables' for each Component can be found in the Key Deliverables Appendix (Appendix 6).

1.1 Component 1: Tools to apply methods for understanding Nitrogen Cycle

Activity 1.1: Development of N System indicators	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 1.1.1 **Development of National N budget approaches**		M				M				M		R		M		
Task 1.1.2 **Development of Farm N budgets**		M				M				M		R				
Task 1.1.3 **Development of NUE approaches**		M			R	M				M R						
Task 1.1.4 **Relating of Level & Effect Indicators to budget indicators**		M	R							M				M R		
Monitoring and Evaluation					R				R				R			R

Activity 1.2 Development of threat assessment methodology	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 1.2.1 **Initial identification of Key Nitrogen Threats**		R														
Task 1.2.2 **Conduct stakeholder review & refine N key threats & criteria**				R												
Task 1.2.3 **Workshop(s) to review assessment methodologies for different N threats**								W								
Task 1.2.4 **Drafting guidance on overall N threat assessment methodology**												R				
Monitoring and Evaluation					R				R				R			

Activity 1.3 Development of methodology for N fluxes and distribution	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 1.3.1 Scoping of N flux and distribution methods (air, land, water, marine, trade)			R													
Task 1.3.2 Conduct reviews of N flux and distribution methods for environ. compartments							R									
Task 1.3.3 Workshop on harmonizing methodologies for key N fluxes and distribution									W							
Task 1.3.4 Preparing guidance on N flux & distribution methods, plus international support													R			
Monitoring and Evaluation					R				R				R			R

Activity 1.4 Development of approaches for N threat-benefit valuation	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 1.4.1 Review of existing threat benefit valuation studies			R													
Task 1.4.2 Refinement of threat benefit valuation across contrasting economies						R										
Task 1.4.3 Integration of food, health, ecosystem, climate & energy benefits & threats						M			R							
Task 1.4.4 Valuation of threats & benefits under future nitrogen scenarios														R		
Monitoring and Evaluation					R				R				R			R

Activity 1.5 Flux-impact path models for assessment, scenarios & strategy evaluation	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 1.5.1 Translation of storylines & scenarios into defined modelling requirements		R														
Task 1.5.2 Review of component models, criteria, data needs, information flow & outputs				R												
Task 1.5.3 Design of model framework in relation to storylines, measures and indicators				W				R								
Task 1.5.4 Application of selected component models in N model cluster								M				R				
Task 1.5.5 Demonstration of N model cluster for key scenarios at global/regional scales												M				
Monitoring and Evaluation					R				R				R			

Activity 1.6 Examination of the barriers achieving to better nitrogen management	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 1.6.1 Examination of economic, cultural & other factors that affect adoption of measures		M	R													
Task 1.6.2 Global/regional examination of N barriers to change in food systems						M					R					
Task 1.6.3 Global/regional examination of N barriers to change in consumption-production						M					R					
Task 1.6.4 Exploration of options to overcome barriers, including the role of a full N approach											M			R		
Monitoring and Evaluation					R				R				R			R

1.2 Component 2: Regional / global quantification of N use, flows, impacts and the quantitative benefits of applying best management practices

Activity 2.1 Quantifying N flows, threats and benefits at global and regional scales	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 2.1.1 Database of shared input, model outcomes & access to measurements		W		R		R										
Task 2.1.2 International support to regional inventories & model application		M				R				R				R		
Task 2.1.3 Combined analysis of present N flows and impacts at global and regional scales						W				R				R		
Task 2.1.4 Quantifying present & future N threats & benefits at global and regional scales		M				M				W				M		
Monitoring and Evaluation					R				R				R			W

Activity 2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 2.2.1 Preparation of scope & structure of consolidated global assessment		W R														
Task 2.2.2 Commissioning of author teams and preparation of the consolidated overview		M				W			W	W						
Task 2.2.3 Peer review of chapters in the global assessment & revision									M							
Task 2.2.4 Preparation of summary docs & review with workshop													W			
Task 2.2.5 Publishing & distribution of consolidated assessment																R W
Monitoring and Evaluation					R				R				R			R

Activity 2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 2.3.1 Preparation of documents on state of the art for N good practices (N form, N effects etc)		W		R												
Task 2.3.2 Workshop to link methods & good practices for N effects (food, water, air, climate etc)						W	R									
Task 2.3.3 Publishing of revised papers and preparation of synthetic guidance document										R						
Task 2.3.4 Peer and Stakeholder review of Synthetic N guidance document												W				
Task 2.3.5 Publishing of synthesis doc & updating of practice database																R
Monitoring and Evaluation					R				R				R			R

Activity 2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 2.4.1 Review of existing N policies for different countries & regions		M		R	M											
Task 2.4.2 Review of existing storylines and scenarios relevant for N		M		R	M											
Task 2.4.3 Workshop on N storylines & scenarios for shared use across the project							W	R								
Task 2.4.4 Synthesis of future programmes and policy options supported by cost benefit analysis									M				R			
Monitoring and Evaluation					R				R				R			R

Activity 2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 2.5.1 Review of N measures adopted by GEF and incorporation into database		M		R												
Task 2.5.2 Review of N measures adopted by others inc from INMS demo regions & inc in database					M		R									
Task 2.5.3 Preparation of compendium of knowledge on N actions implemented by GEF & others				R	M				R							
Monitoring and Evaluation					R				R				R			R

1.3 Component 3: Regional demonstration of Full Nitrogen Approach

Activity 3.1 Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Tasks 3.1.1 & 3.1.2 Examination of N flows by source sector & loss pathway; inc improving access to data		M				M			W							
Task 3.1.3 Identifying & quantifying major uncertainties and means to improve																
Tasks 3.1.4 & 3.1.5 Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA		M							W							
Task 3.1.6 Description in relation to N performance indicators, in co-operation with global analysis									W			R				
Task 3.1.7 Review of available options for mitigation/better N management, co-benefits/trade-offs		M							W			R				
Task 3.1.8 Profiling success stories, barriers to change, and demonstration of N joined up approach									W			R				
Task 3.1.9 Contribution to scenario development in cooperation with global analysis		M				M						R				
Monitoring and Evaluation					R				R				R			R

Activity 3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 3.2.1 Preparation of scope, agenda and workshop, with documentation in cooperation with global framing									R							
Task 3.2.2 Hosting of workshop bringing together regional demos in cooperation with global partners										M						
Task 3.2.3 Peer review and publication of the synthesis document													R			
Monitoring and Evaluation													R			R

Activity 3.3 Building consensus on benchmarking N indicators for different regions and systems	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 3.3.1 Regional contribution to scoping paper in cooperation with A1.1							R				R					
Task 3.3.2 Regional attendance at INMS workshop sessions with focus on indicator benchmarking	W				W				W			W				W
Monitoring and Evaluation																

Activity 3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4
Task 3.4.1 Preparation of briefing on rationale and approach for INMS regional demonstration	R															
Task 3.4.2 Revision of regional approach using stakeholder feedback and considering regional priorities				W				W				W				
Task 3.4.3 Engagement and dissemination of the INMS approach to regional N cycle assessment																W
Monitoring and Evaluation					R				R				R			R

1.4 Component 4: Awareness raising and knowledge sharing

Activity 4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement)	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4
Task 4.1.1 **Establishment, population & operation of INMS web portal**	I															
Task 4.1.2 **Establishment & maintenance of INMS database including links to other data sources**																
Task 4.1.3 **Develop communications function for INMS partners**	S															
Task 4.1.4 **Develop press and public engagement function for INMS**		S														
Monitoring and Evaluation					R				R				R			R

Activity 4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4
Task 4.2.1 **Training in nitrogen measurement, modelling and mitigation techniques**					M				R					W		R
Task 4.2.2 **International engagement of the project to foster better understanding of N challenges**				R										R		
Task 4.2.3 **Share experiences on N foot-printing as a means of developing public awareness**						W		R			W			R		
Monitoring and Evaluation					R				R				R			R

Activity 4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & development of long-term strategy	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 4.3.1 Development of synthesis to demonstrate INMS in support of GPA objectives					M				M				M			
Task 4.4.1 Coordination of INMS inputs to other policy processes						M			M			M			M	
Task 4.4.2 Development of a long-term strategy for INMS, inc. policy homes & financing models					M		R				M			R		
Monitoring and Evaluation					R				R				R			R

Activity 4.5 Harmonization, publication & dissemination of guidance documents across components	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 4.5.1 Harmonization & publication of guidance on N budgets, efficiency & benchmarking										M						
Task 4.5.2 Harmonization and publication of guidance on threats, fluxes & distribution methods												R[1]	R[2]			
Task 4.5.2 Harmonization & publication on N measures and good practices inc. barriers and successes													R[3]			R[4]
Monitoring and Evaluation					R				R				R			R

[1] Threats, [2] N fluxes and distribution, [3] Barriers in food production & consumption-production, [4] Good practices

Activity 4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4
Task 4.6.1 **Provide 1% of project resources to support IW:LEARN**																
Task 4.7.1 **Connect INMS website with IW-LEARN & other GEF systems**																
Task 4.8.1 **Cooperate with IW-LEARN and STAP inc. development of a N Community of Practice (CoP).**						M										
Task 4.9.1 **Participate in Int. Waters Conferences and prepare INMS Experience Notes**									M							
Monitoring and Evaluation					R				R				R			R

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 06

Key Deliverables

[P] – Process Indicator; [SR] – Stress Reduction Indicator; [ES] – Ecosystem and Socio-Economic Indicator

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
Component 1:Tools for understanding & managing the global N cycle					
Activity 1.1 Development of National N budget approaches					
T1.1.1	Development of National N budget approaches	Guidance Document on National Nitrogen budgets available and accepted. [P]	Guidance document published	Consensus on methodology achieved	Consensus achieved in Year 3, ahead of final report drafting
T1.1.2	Development of Farm N budgets	Guidance Document on Farm N budgets available and accepted. [P]	Guidance document published	Consensus on methodology achieved	Consensus achieved in Year 3, ahead of final report drafting
T1.1.3	Development of NUE approaches	Guidance Document on NUE methodology for different purposes available and accepted [P]	Guidance document published	Consensus on methodology achieved	Consensus achieved in Year 3, ahead of final report drafting
T1.1.4	Relating of Level & Effect Indicators to budget indicators	Guidance Document on relating Level & Effect indicators to budget indicators available and accepted [P]	Guidance document published	Consensus on methodology achieved	Consensus achieved in Year 4, ahead of final report drafting

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
Activity 1.2 Development of threat assessment methodology					
T1.2.1	Initial identification of Key Nitrogen Threats	Consultation document on key N threats and criteria for policy & other stakeholders available and accepted [P]	Consultation document available and distributed	Consensus on key N threats and criteria for policy & other stakeholders achieved	Consensus achieved early in Year 1, ahead of report delivery.
T1.2.2	Conduct stakeholder review & refine N key threats & criteria	Summary of stakeholder feedback and revised set of key N threats and criteria available and accepted [P]	Revised set of key N threats and criteria document available	Consensus on revised key N threats and criteria for policy & other stakeholders achieved	Consensus achieved before end of Year 1, ahead of report delivery.
T1.2.3	Workshop(s) to review assessment methodologies for different N threats	Workshops on N threat assessment methodologies with synthesis on links held [P]	Workshop report on N threat assessment methodologies available.	Workshop held.	Workshop held by end Year 2.
T1.2.4	Drafting guidance on overall N threat assessment methodology	Guidance Document on integrated N threat assessment methodology & compendium of primary documents available and accepted [P]	Guidance Document on integrated N threat assessment methodology published	Consensus on integrated N threat assessment methodology achieved	Consensus achieved in Year 3, ahead of report delivery.
Activity 1.3 Development of methodology for N fluxes and distribution					
T 1.3.1	Scoping of N flux and distribution methods (air, land, water, marine, trade)	Scoping report on N flux & distribution methods (air, land, water, marine, trade) available and accepted [P]	Scoping report on N flux & distribution methods (air, land, water, marine, trade) available and distributed	Consensus on scoping report on N flux & distribution methods (air, land, water, marine, trade) achieved.	Consensus achieved in Year 1, ahead of report delivery.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T 1.3.2	Conduct reviews of N flux and distribution methods for environ. compartments	Background Documents on N flux and distribution methods (to support workshop) available and accepted [P]	Background Documents on N flux and distribution methods (to support workshop) circulated in advance of workshop	Consensus on N flux and distribution methods in background document achieved	Consensus achieved in Year 2, ahead of workshop.
T1.3.3	Workshop on harmonizing methodologies for key N fluxes and distribution	Workshop held on methods for N fluxes & distribution with synthesis [P]	Workshop report on methods for N fluxes & distribution with synthesis available	Workshop held	Workshop held early in Year 3.
T1.3.4	Preparing guidance on N flux & distribution methods, plus international support	Guidance Documents on N flux and distribution methods with compendium of primary documents available and accepted [P]	Guidance Documents on N flux and distribution methods published	Consensus on N flux and distribution methods achieved.	Consensus achieved early in Year 4 ahead of publication.
Activity 1.4 Development of approaches for N threat-benefit valuation					
T1.4.1	Review of existing threat benefit valuation studies	Status report on N threat benefit valuation identifying key gaps & challenges available and accepted [P]	Status report on N threat benefit valuation identifying key gaps & challenges delivered	Consensus on N threat benefit valuation identifying key gaps & challenges achieved	Consensus achieved in Year 1, ahead of report delivery.
T1.4.2	Refinement of threat benefit valuation across contrasting economies	INMS briefing note summarising main principles of threat-benefit valuation conducted across contrasting economies available and accepted [P]	INMS briefing note summarising main principles of threat-benefit valuation conducted across contrasting economies delivered	Consensus on main principles of threat-benefit valuation achieved	Consensus achieved in Year 2, ahead of briefing note delivery.
T 1.4.3	Integration of food, health, ecosystem, climate & energy benefits & threats	Methodology for linked valuation of multiple nitrogen benefits & threats available and accepted [P]	Meeting report on methodology delivered.	Meeting to develop methodology held.	Meeting held during through Year 2.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T1.4.4.	Valuation of threats & benefits under future nitrogen scenarios	Document on valuation of benefits and threats for future nitrogen scenarios available and accepted [P]	Document on valuation of benefits and threats for future nitrogen scenarios delivered	Consensus on valuation of benefits and threats for future nitrogen scenarios achieved	Consensus achieved in Year 4, before delivery of document.
Activity 1.5 Flux-impact path models for assessment, scenarios & strategy evaluation					
T1.5.1	Translation of storylines & scenarios into defined modelling requirements	INMS working document summarising the INMS modelling strategy including proposed approach to storylines and scenarios available and accepted [P]	First draft of the INMS working document summarising the INMS modelling strategy delivered	Consensus on first draft on INMS working document summarising the INMS modelling strategy agreed	Consensus achieved early in Year 1, before delivery of first draft of document.
T1.5.2	Review of component models, criteria, data needs, information flow & outputs	Document on component models, data, info flow & outputs available including links to the INMS models database [P]	Document on component models, data, info flow & outputs delivered	Consensus on component models, data, info flow & outputs achieved	Consensus reached by end Year 1, before report is delivered.
T1.5.3	Design of model framework in relation to storylines, measures and indicators	Document on criteria & necessary components for integrated N modelling cluster available and accepted [P]	Workshop report on criteria & necessary components for integrated N modelling cluster delivered	Workshop held.	Workshop held by end Year 1.
T1.5.4	Application of selected component models in N model cluster	Demonstrated output for model cluster, linking N flows & effects global & regional [P]	Meeting report on planning of the model cluster work	Meeting held.	Meeting held by end Year 2.
T1.5.5	Application of N model cluster for key scenarios at global/regional scales	Report on N flux/pathway modelling approach for global/regional scenarios available and accepted [P]	Report on N flux/pathway modelling approach for global/regional scenarios delivered	Application of the INMS model cluster for a selection of cases.	Results from application of INMS model cluster delivered to component 2, by end Year 3.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
Activity 1.6 Examination of the barriers achieving to better nitrogen management					
T1.6.1	Examination of economic, cultural & other factors that affect adoption of measures	Report on the economic & cultural factors helping/ hindering adoption of options available and accepted [P]	Meeting report on the economic & cultural factors helping/ hindering adoption of options	Meeting held	Meeting held early in Year 1.
T1.6.2	Global/regional examination of N barriers to change in food systems	Report on global/regional barriers to better N management in the food system available and accepted [P]	Report from meeting on global/regional barriers to better N management in the food system delivered	Meeting held.	Meeting held midway year 2.
T 1.6.3	Global/regional examination of N barriers to change in consumption-production	Report on N barriers for global/ regional consumption-production available and accepted [P]	Report from meeting on N barriers for global/ regional consumption-production delivered	Meeting held.	Meeting held midway year 2.
T 1.6.4	Exploration of options to overcome barriers including the role of a full N approach	Report informing global analysis & regional demos on overcoming barriers to change available and accepted [P]	Report informing global analysis & regional demos on overcoming barriers to change delivered	Consensus achieved on report informing global analysis & regional demos on overcoming barriers to change	Consensus achieved early in Year 4, before delivery of the report.
Component 2: Regional / global quantification of N use, flows, impacts and the quantitative benefits of applying best management practices					
Activity 2.1 Quantifying N flows, threats and benefits at global and regional scales					
T 2.1.1	Database of shared input, model outcomes & access to measurements	Database established & populated, common datasets, results & access to sources [P]	Report from workshop held to establish needs of the INMS database(s)	Workshop held.	Workshop held by middle of Year 1.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T 2.1.2	International support to regional inventories & model application	Regional demonstrations supported with inventory expertise and models [P]	Report on first call for supporting activities delivered Report on calls in Years 3 & 4 delivered.	First call organised and administered. Calls in Years 3 & 4 delivered.	First call organised during Year 2. Second and third calls organised in Years 3 & 4.
T 2.1.3	Combined analysis of present N flows and impacts at global and regional scales	Report with data shared on global & regional N flows, threats & benefits available and accepted [P]	Report from workshop on global & regional N flows, threats & benefits delivered. Final report on global & regional N flows, threats & benefits delivered.	Workshop held. Consensus achieved on report global & regional N flows, threats & benefits available.	Workshop held during Year 2. Consensus achieved early in Year 4, before delivery of the report.
T 2.1.4	Quantifying present & future N threats & benefits at global and regional scales	Report comparing present situation with future scenarios of benefits and threats available and accepted [P]	Report from first meeting held to compare present situation with future scenarios of benefits and threats delivered Report from final meeting held to compare present situation with future scenarios of benefits and threats delivered	Meeting held. Meeting held.	Meeting held during Year 2. Meeting held during Year 4.
Activity 2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations					
2.2.1	Preparation of scope & structure of consolidated global assessment	Scope & outline structure of global assessment of N fluxes, pathways & impacts available and agreed [P]	Scope & outline structure of global assessment of N fluxes, pathways & impacts delivered	Scope and outline structure agreed.	Scope and outline structure agreed during Year 1.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T 2.2.2	Commissioning of author teams and preparation of the consolidated overview	Authors appointed and outline chapter drafts available and agreed [P]	Report from workshop on appointing authors and scoping outlines for chapter drafts	Workshop held.	Workshop held during Year 2.
T 2.2.3	Peer review of chapters in the global assessment & revision	Peer review of chapters in the global assessment & revision achieved [P]	Report to PPA on peer review process for Global Assessment	Presentation to PPA regarding the peer review process for Global Assessment	Report to PPA on peer review process for Global Assessment by Year 3.
T 2.2.4	Preparation of summary docs & review with workshop	Documents reviewed by PPA, SPAG & other stakeholders [P]	Report from review workshop	Review workshop held.	Review workshop held by Year 4.
T 2.2.5	Publishing & distribution of consolidated assessment	Published report with wide public dissemination [P]	Report published and launched in hardcopy.	Launch held.	Launch held by end of project.
Activity 2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr					
T 2.3.1	Preparation of documents on state of the art for N good practices (N form, N effects etc)	Background documents produced & available at workshop [P]	Background documents delivered	Outline for background document scope agreed.	Outline for background document scope agreed by end Year 1.
T 2.3.2	Workshop to link methods & good practices for N effects (food, water, air, climate etc)	Basis for developing guidance linking N forms & issues, high-lighting most promising options available and accepted [P]	Report from workshop on developing guidance linking N forms & issues, high-lighting most promising options delivered	Workshop held.	Workshop held during Year 2.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T 2.3.3	Publishing of revised papers and preparation of synthetic guidance document	First draft of guidance doc synthesized for wide review available and accepted [P]	First draft of guidance doc delivered.	Skeleton for guidance document agreed.	Skeleton for guidance document agreed by Year 3.
T 2.3.4	Task 2.3.4 Peer and Stakeholder review of Synthetic N guidance document	Text of consolidated guidance document available and accepted [P]	Report from workshop on consolidating guidance document text delivered.	Workshop held.	Workshop held by end Year 3.
T 2.3.5	Task 2.3.5 Publishing of synthesis doc & updating of practice database	Consolidated methods/practice report available and accepted & database published [P]	Consolidated methods/practice report delivered & database populated	Consensus on finalized text achieved.	Consensus on finalized text achieved during Year 4, before report is published.
Activity 2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis					
T 2.4.1.	Review of existing N policies for different countries & regions	Database and report on N policies, storylines & scenarios available [P]	Database populated and report on N policies, storylines & scenarios delivered	Consensus on report draft achieved.	Consensus achieved later in Year 1.
T 2.4.2	Review of existing storylines and scenarios relevant for N	Background document on N policies & scenarios available and accepted [P]	Report from meeting to develop background document on N policies & scenarios	Meeting held.	Meeting held during Year 1.
T 2.4.3	Workshop on N storylines & scenarios for shared use across the project	Strategy for N storylines and scenarios available and accepted [P]	Report from workshop on strategy for N storylines and scenarios	Workshop held.	Workshop held by end Year 2.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T 2.4.4	Synthesis of future programmes and policy options supported by cost benefit analysis	Report on N policy options & their possible contribution to the Green Economy available and accepted [P]	Agenda for planned document development meeting agreed	Meeting held.	Meeting held by start of Year 3.
Activity 2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr					
T 2.5.1	Review of N measures adopted by GEF and incorporation into database	Database and summary document on GEF N measures available and accepted [P]	Database populated and summary report on GEF N Measures delivered	Review of relevant GEF measures completed.	Review completed in Year 1.
T 2.5.2	Review of N measures adopted by others inc from INMS demo regions & inc in database	Database and summary document on N measures adopted by others available and accepted [P]	Database populated and summary report on non- GEF N Measures delivered	Review of relevant measures completed.	Review of relevant GEF measures conducted in Year 3.
T 2.5.3	Preparation of compendium of knowledge on N actions implemented by GEF & others	Synthesis supported by data-base on N actions as contrib. to global assessment available and accepted [P]	Verbal report to annual INMS meeting on developing a compendium of N actions and updates to database	Report given.	Report given by Year 3.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
Component 3: Regional demonstration of Full Nitrogen Approach					
Activity 3.1 Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.					
T 3.1.1 & 3.1.2	Examination of N flows by source sector & loss pathway; inc improving access to data	Main N flows quantified by source sector & pathway; better data access & understanding for 5 regions by end Year 3. [P]	Reports from meetings to quantify main N flows, facilitate better data access and understanding for 5 regions.	Meetings held in 5 regions.	Meetings held in Year 2.
T 3.1.3	Identifying & quantifying major uncertainties and means to improve	Quantification of major N source sectors with estimated uncertainties for 5 regions by end Year 3. [P]	Reports to demonstration management group meetings on quantification of major N source sectors with estimated uncertainties for 5 regions.	Demonstration management group meetings held in 5 regions.	Demonstration management group meetings held in 5 regions during Year 2.
T 3.1.4 & 3.1.5	Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	Key N benefits/threats quantified & regional priorities identified with policymakers & others in 5 regions [P]	Report from policymaker workshop to quantify key N benefits/threats & regional priorities in 5 regions, delivered	Policymaker workshops held.	Workshops held in Year 3.
T 3.1.6	Description in relation to N performance indicators, in co-operation with global analysis	Basis to compare regions in relation to agreed performance indicators for 5 regions available and agreed [P]	Report from workshop on basis to compare regions in relation to agreed performance indicators for 5 regions delivered	Workshop held.	Workshop held in Year 3.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T 3.1.7	Review of available options for mitigation/better N management, co-benefits/trade-offs	Document on N mitigation/management options identifying win-wins & regional priority list of options available and agreed for 5 regions [P]	Reports from workshops, on priority measures for improved N management, for each regional demo delivered.	Workshops held.	Workshops held in Year 3.
T 3.1.8	Profiling success stories, barriers to change, and demonstration of N joined up approach	Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers available and agreed [P] Working toward 20% improvement of Nutrient Use Efficiency (NUE) in selected demonstration regions [SR] Demonstration of how joined up approach is leading to simultaneous reduction in water, air & climate pollution [SR]	Report from workshop to develop synthesis of benefits of a 'full N approach' for 5 regions delivered Documentation with supporting evidence of NUE improvement. Datasets reporting improvement.	Workshops held. Comparison with quantified baseline for 2010 or 2015. Comparison with conditions in 2010 or 2015.	Workshops held in Year 3. By end Year 4. By end Year 4.
T 3.1.9	Contribution to scenario development in cooperation with global analysis	Global N scenarios informed by evidence from the regional demonstrations [P]	Report from management board meetings confirming scenarios fit for purpose, for 5 regions, delivered	Demonstration management meetings held, where proposals are discussed.	Meetings held in Year 2.
Activity 3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits					
T 3.2.1	Preparation of scope, agenda and workshop, with documentation in coop with global framing	Advance background documents for each regional demo according to a common template available [P]	Advance background documents for each regional demo delivered	Common template for background documents, agreed	Common template agreed in Year 2.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T 3.2.2	Hosting of workshop bringing together regional demos in cooperation with global partners	Basis for preparing synthesis publication on shared lessons from the regional demonstrations [P]	Report from workshop on preparing synthesis publication on shared lessons from the regional demonstrations delivered	Workshop held.	Workshop held in Year 3.
T 3.2.3	Peer review and publication of the synthesis document	Authoritative synthesis published on the regional experiences in improving N management [P]	Synthesis published on the regional experiences in improving N management	Draft structure of report agreed. Consensus on finalized text achieved.	Draft structure agreed in Year 3. Consensus agreed in Year 4.
Activity 3.3 Building consensus on benchmarking N indicators for different regions and systems					
T 3.3.1	Regional contribution to scoping paper in cooperation with A1.1	Scoping paper on benchmarking N indicators informed with regional perspectives available and agreed [P]	Documents on regional perspectives delivered to A1.1.	Draft structure agreed in 5 regions.	Draft structure agreed in 5 regions in Year 3.
T 3.3.2	Regional attendance at INMS workshop sessions with focus on indicator benchmarking	Joint report informed with regional perspectives on benchmarking N indicators [P]	Regional attendance from all 5 regions at INMS workshop sessions with focus on indicator benchmarking	Workshop sessions held.	Workshop sessions held in Years 1, 2, 3 & 4.
Activity 3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management					
T 3.4.1	Preparation of briefing on rationale and approach for INMS regional demonstration	Briefing document available for testing with stakeholders [P]	Briefing document delivered	Briefing document outlined.	Briefing document outlined at start of project.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T 3.4.2	Revision of regional approach using stakeholder feedback and considering regional priorities	Revised briefing document on common approach accounting for regional priorities [P]	Reports from 3 workshops to revise common approach	Workshops held.	Workshops held in Years 1, 2 & 3.
T 3.4.3	Engagement and dissemination of the INMS approach to regional N cycle assessment	Recognition of INMS N cycle approach with GPA & other international frameworks [P]	Report on wider engagement activities in showing the role of regional information in nitrogen cycle assessment	Documented interaction with GPA and other international frameworks demonstrating mobilization of full N approach.	By Year 4.
Component 4: Awareness raising and knowledge sharing					
Activity 4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement)					
T 4.1.1	Establishment, population & operation of INMS web portal	INMS web portal established and populated [P]	INMS web portal is fully functional with dedicated content for partners, public, press	INMS web portal is online	INMS web portal is online in Year 1 Q1.
T 4.1.2	Establishment & maintenance of INMS database including links to other data sources	INMS database established and populated [P]	INMS database ready for both upload and download of data, online guidance completed	INMS database online.	INMS database online in Year 1.
T 4.1.3	Task 4.1.3 Develop communications function for INMS partners	Regular information provided to partners, through web portal, newsletters etc [P]	Partner contact systems delivered. Reports from INMS Annual Meetings.	Partner contact lists established & newsletter concept developed. INMS Annual Meetings held.	Partner contact list and newsletter concept established at start of project.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T 4.1.4	Develop press and public engagement function for INMS	Press and public engagement strategy developed. [P] Audience specific products for press and public developed [P] Network of nitrogen champions developed [P]	Project press and public engagement strategy delivered Web portal updated with press specific content and public engagement items 15 nitrogen champions recruited and trained, nitrogen champion specific materials uploaded to web portal.	First draft of press and public engagement strategy developed Web portal section for press specific content developed Nitrogen champion's recruitment and training strategy developed.	First draft of press and public engagement strategy developed in Q1 year 1. Web portal section for press specific content developed in Q2 Year 1. Nitrogen champion's recruitment and training strategy developed in Year 1.
Activity 4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting					
T 4.2.1	Training in nitrogen measurement, modelling and mitigation techniques	Training plan developed, trainings attended, training materials available [P]	Training strategy developed and delivered	First draft of training plan developed	Training plan developed in Year 1.
T 4.2.2	International engagement of the project to foster better understanding of N challenges	Meetings attended, discussions of INMS held by country representatives and at meetings of intergovernmental processes [P]	INMS discussed at 3 meetings of an intergovernmental process	Meetings attended and profile of INMS raised.	Meetings attended in Years 2 & 4.
T 4.2.3	Share experiences on N foot-printing as a means of developing public awareness	Workshop held, further N footprinting tools developed [P]	Report from workshop on N Footprinting held, plans for further development agreed	Workshop on N Footprinting held.	Workshop on N Footprinting held in Year 2.
Activity 4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & development of long-term strategy					

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
T 4.3.1	Development of synthesis to demonstrate INMS in support of GPA objectives	Key messages developed and visible. [P] Guidance documents published and disseminated [P] INMS Annual Meetings held, with stakeholder interaction [P] Events held with intergovernmental processes and conferences [P]	Key messages added to web portal. Guidance documents added to web portal. Reports from 5 INMS Annual Meetings. Reports from events held with intergovernmental processes, UNEA meetings, IW Conferences. INMS contributes to 2 UNEA and 2 IW conferences	Key messages agreed. Guidance documents published. 5 INMS Annual Meetings held. Events attended/organised. Events attended/organised.	Key messages agreed in Year 4. Guidance documents published in Year 4. INMS Annual Meetings held at start of project, Year 1, Year 2, Year 3, Year 4. Events attended/organised in Years 1, 2, 3 & 4. Events attended/organised.
T 4.4.1	Coordination of INMS inputs to other policy processes	Harmonised messages emerging from the project, opportunities for 'policy intervention points' taken, engagement with Nitrogen champions [P]	Key messages relevant to policy processes agreed and posted onto web portal Reports from policy intervention activities delivered. Report on nitrogen champion activities.	Emerging messages discussed at 3rd Partners Project Assembly First draft of policy intervention strategy developed Training plan (including activities of nitrogen champions) developed.	Emerging messages discussed at 3rd Partners Project Assembly – end of Year 2. First draft of policy intervention strategy developed in Year 1. Training plan (including activities of nitrogen champions) developed in Year 1.
T 4.4.2	Development of a long-term strategy for INMS, inc. policy homes & financing models	Long-term strategy for INMS documented and communicated, including financing models [P]	Long-term INMS strategy added to web portal.	First draft of long-term INMS strategy completed. Long-term INMS strategy finalized.	First draft of long-term INMS strategy completed in Year 2. In Year 4.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
Activity 4.5 Harmonization, publication & dissemination of guidance documents across components					
T 4.5.1	Harmonization & publication of guidance on N budgets, efficiency & benchmarking	Publication of guidance document, common style and approach visible [P]	Guidance document added to web portal.	Common style & approach for guidance document agreed.	Common style & approach for guidance documents agreed in Year 4.
T 4.5.2	Harmonization and publication of guidance on threats, fluxes & distribution methods	Publication of guidance document, common style and approach visible [P]	Guidance document added to web portal.	Common style & approach for guidance document agreed.	Common style & approach for guidance documents agreed in Year 4.
T 4.5.3	Harmonization & publication on N measures and good practices inc. barriers and successes	Publication of guidance document, common style and approach visible [P]	Guidance document added to web portal.	Common style & approach for guidance document agreed.	Common style & approach for guidance documents agreed in Year 4.
Activity 4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP					
	Task 4.6.1 Provide 1% of project resources to support IW:LEARN	Participation in IW Conferences [P]	Reports from IW conferences.	INMS representation at IW conferences.	INMS representation at IW conferences in Years 2 & 4.
	Task 4.7.1 Connect INMS website with IW-LEARN & other GEF systems	Number of links made between INMS and IW:LEARN and other IW projects [P]	INMS website clearly linked to IW:LEARN	Links to IW:LEARN systems developed.	Links to IW:LEARN systems developed in Year 1.

	Sub-activities	Expected Result [with SMART indicator type]	Deliverables	Benchmark	Timeframe
	Task 4.8.1 Cooperate with IW-LEARN and STAP inc. development of a N Community of Practice (CoP).	Visible Nitrogen CoP on the INMS web portal [P]	Nitrogen CoP site established on INMS web portal and populated	First draft of N CoP structure developed.	First draft of N CoP structure developed in Year 1.
	Task 4.9.1 Participate in Int. Waters Conferences and prepare INMS Experience Notes	Participation in IW Conferences, experience notes visible [P]	Reports from IW Conferences and experience notes added to web portal.	INMS representatives attend IW Conferences.	INMS representatives attend IW Conferences in Years 2 & 4.

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 07

Costed Monitoring and Evaluation Plan

Table of Contents

1 Background

The project will follow UNEP standard monitoring, reporting and evaluation processes and procedures. Substantive and financial project reporting requirements are summarized in Appendix 8 of the Project Document. Reporting requirements and templates are an integral part of the UNEP legal instruments to be signed by the executing agency (CEH on behalf of INI) and UNEP. For the purposes of M&E activities (and the reading of this document), the Project Co-ordinator will function under the direct supervision and control of the Project Director to fulfil the M&E needs.

The project M&E plan is consistent with the GEF Monitoring and Evaluation policy. The Project Results Framework presented in Appendix 4 includes Specific, Measurable, Achievable, Relevant and Time-bound (SMART) indicators and targets for each expected outcome. These indicators along with the key deliverables and benchmarks included in Appendix 6 will be the main tools for assessing project implementation progress and whether project results are being achieved. The means of verification and the costs associated with obtaining the information to track the indicators are summarized in the tables at the end of this appendix (sections 4 and 5 of this appendix). M&E related costs are presented and are fully integrated in the overall project budget.

The M&E plan will be presented to the first meeting of the Project Management Board (PMB) to ensure project stakeholders understand their roles and responsibilities vis-à-vis project monitoring and evaluation. The PMB will be responsible for proposing to UNEP management any necessary amendments to the M&E plan during project implementation. Indicators and their means of verification may also be fine-tuned by the PMB. Day-to-day project monitoring is the responsibility of the PCU but other project partners will have responsibilities to collect specific information to track the indicators. It is the responsibility of the Project Co-ordinator to inform UNEP of any delays or difficulties faced during implementation so that the appropriate support or corrective measures can be adopted in a timely fashion.

The PMB will receive periodic reports on progress and will make recommendations to UNEP concerning the need to revise any aspects of the Results Framework or the M&E plan. Project oversight to ensure that the project meets UNEP and GEF policies and procedures is the responsibility of the UNEP Task Manager. The Task Manager will also review the quality of draft project outputs, provide feedback to the project partners, and establish peer review procedures to ensure adequate quality of scientific and technical outputs and publications.

The Project Co-ordinator will develop a project supervision plan at the inception of the project, which will be communicated to the project partners during the first meeting of the PMB. The Project Co-ordinator will also be responsible for initial screening of the financial and administrative reports from the core partners prior to their submission to the Finance and Management Divisions of the United Nations Office at Nairobi. Progress vis-à-vis the delivery of agreed project outputs will be assessed by the PMB and endorsed by the PPA at least annually. Project risks and assumptions will be regularly reviewed both by project partners and the PCU on behalf of UNEP. Risk assessment and rating is an integral part of the annual Project Implementation Review (PIR), preparation of which will be the responsibility of the Project Manager. The quality of project monitoring and evaluation will be reviewed and rated as part of the PIR, which will be approved by the PMB. Key financial parameters will be monitored quarterly to ensure cost-effective use of financial resources.

A mid-term management evaluation (MTE) will be conducted by the Evaluation Office (however, MTEs are only conducted for projects of high strategic importance or that are rated as being at risk) in consultation with the Project Co-ordinator and an external consultant, with the outcomes reported to the Project Management Board. An independent terminal evaluation will take place at the end of project implementation in accordance with UNEP and GEF procedures. The Evaluation Office of UNEP will manage the terminal evaluation processes.

The GEF tracking tool is attached as Appendix 14. This will be established at the start of the project, and updated at mid-term and at the end of the project. The Tracking Tool will be made available to the GEF Secretariat along with the project PIR report.

2 Monitoring and Evaluation Responsibilities and Activities

At the first meeting of the PMB the Project Co-ordinator will present a full 48 month schedule including (i) tentative time frames for Management Board Meetings and meetings of the Stakeholder Policy Advisory Group and (ii) project related Monitoring and Evaluation activities.

Day to day monitoring of implementation progress will be the responsibility of the Project Co-ordinator based on the Project's Annual Work Plan and its indicators. The Project Co-ordination Unit will inform UNEP and the partner executing agencies of any delays or difficulties faced during implementation so that the appropriate support or corrective measures can be adopted in a timely and remedial fashion. The Project Co-ordinator will fine-tune the progress and performance/impact indicators of the Project in consultation with the full Project team and with support from UNEP and the partners. These indicators will be used to assess whether implementation is proceeding at the intended pace and in the right direction and will form part of the Annual Work Plan (AWP). Targets and indicators for the second year will be defined as part of the internal evaluation and planning processes undertaken by the Project Team and will be approved by the Project Board.

Periodic monitoring of implementation progress will be undertaken by UNEP and the EA through the provision of half-yearly reports submitted by the PCU. Furthermore, specific meetings can be scheduled between the PCU, UNEP, the PMB and other pertinent stakeholders as deemed appropriate and relevant. Such meetings will allow parties to address problems pertaining to the Project in a timely fashion and to ensure smooth implementation of project activities.

2.1 Project Monitoring Reporting

The Project Co-ordinator will be responsible for the preparation and submission of the following reports that form part of the monitoring process, in collaboration with UNEP, Component, Activity and Task Leaders.

2.1.1 Inception Report

At the start of the project an 'Inception Meeting' will be held, at which time the Project Management Board and Project Partners Assembly (see Appendix 10 for further information), will meet to discuss the Work Plan. Immediately following this meeting a Project Inception Report (IR) will be prepared, including a detailed First Year Work Plan divided in quarterly time-frames detailing the activities and progress indicators that will guide implementation during the first year of the Project. This Work Plan will include the proposed dates for any visits and/or support missions from UNEP, EA or consultants, as well as time-frames for meetings of the PMB and Stakeholder and Policy Advisory Group. The Report will also include the detailed project budget for the first full year of implementation, prepared on the basis of the Annual Work Plan, and including any monitoring and evaluation requirements to effectively measure project performance during the targeted 12 months.

The Inception Report will include a detailed narrative on the institutional roles, responsibilities, coordinating actions and feedback mechanisms of project related partners. In addition, a section will be included on progress to-date on project establishment and start-up activities and an update of any changed external conditions that may affect project implementation, including any unforeseen or newly arisen constraints.

2.1.2 Progress reports

The **Half-yearly Progress Report** is a self-assessment report by the PCU to the UNEP Office and provides them with input to the reporting process as well as forming a key input to the Project Review undertaken by the Project Management Board.

The Project Implementation Review is an annual monitoring process mandated by the GEF, to be conducted by the UNEP Task Manager (TM) in consultation with the EA. It has become an essential monitoring tool for project managers and offers the main vehicle for extracting lessons from ongoing projects. In addition the UNEP Task Manager will submit to UNEP Evaluation Office an annual project report, which is a UNEP self-evaluation tool.

An **Annual Project Report** (APR) is prepared on an annual basis. The purpose of the Annual Project Report is to reflect progress achieved in meeting the project's Annual Work Plan and assess performance of the project in contributing to intended outcomes through outputs and partnership work. The Annual Project Report and Project Implementation Review (PIR) are discussed in the Project Management Board so that the resultant report represents a document that has been agreed upon by all of the primary stakeholders and presented to the PPA.

The items in the APR/PIR to be provided include the following:

- An analysis of project performance over the reporting period, including outputs produced and, where possible, information on the status of the outcome;
- The constraints experienced in the progress towards results and the reasons for these;
- The three (at most) major constraints to achievement of results;
- Annual Work Plans and related expenditure reports;
- Lessons learned; and
- Clear recommendations for future orientation in addressing key problems in lack of progress.

UNEP analyses the Annual Project Report and Project Implementation Review for results and lessons. The Reports are also valuable for the Independent Evaluators who can utilize them to identify any changes in project structure, indicators, Work Plan, etc. and view a past history of delivery and assessment.

2.1.3 Periodic Thematic Reports

As and when called for by UNEP or the EA, the PCU in collaboration with the relevant Component, Task or Activity Leaders will prepare Specific Thematic Reports, focusing on specific issues or areas of activity. The request for a Thematic Report will be provided to the PCU in written form by UNEP/EA and will clearly state the issue or activities that need to be reported on. These reports can be used as a form of lessons learnt exercise, specific oversight in key areas, or as troubleshooting exercises to evaluate and overcome obstacles and difficulties encountered.

2.1.4 Project Terminal Report
During the last three months of the project the PCU in collaboration with the PMB and the Component Leaders will prepare the Project Terminal Report. This comprehensive report will summarize all activities, achievements and outputs of the Project, lessons learnt, objectives met, or not achieved, structures and systems implemented, etc. and will be the definitive statement of the Project's activities during its lifetime. It will also lay out recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the Project's activities.

2.1.5 Technical Reports
Technical Reports are detailed documents covering specific areas of analysis or scientific specializations within the overall project. As part of the Inception Report, the project team will prepare a draft Reports List, detailing the technical reports that are expected to be prepared on key areas of activity during the course of the Project, and tentative due dates. Where necessary this Reports List will be revised and updated, and included in Annual Project Reports.

2.1.6 Project Publications
Project Publications will form a key method of crystallizing and disseminating the results and achievements of the Project. These publications on the activities and achievements of the Project, in the form of journal articles, multimedia publications, etc. A number of reports are already planned within the project, detailed in the results framework (Appendix 4). The PMB will determine if any further Technical Reports merit formal publication. In consultation with UNEP, the Project Partners Assembly and other relevant stakeholder groups, the production of these publications will be handled in a consistent and recognizable format. This is also undertaken within Activity 4.5. Any publications need prior clearance from UNEP and the endorsement by the PPA. Project resources have been defined and allocated for existing panned reports and the use of resources for further reports will be considered and commensurate with the project's budget.

2.2 Independent Evaluation
In-line with UNEP Evaluation Policy and the GEF's Monitoring and Evaluation Policy the project will be subject to a Terminal Evaluation and, additionally, a Mid-Term Review will be commissioned and launched by the Project Manager before the project reaches its mid-point. If project is rated as being at risk, a Mid-Term Evaluation will be conducted by the Evaluation Office.

2.2.1 Mid-Term Review
A Mid-Term Review (MTR) will be conducted by the Task Manager (unless the project is deemed to be of high-strategic importance or rated at being at risk, in which case the UNEP office will commission a Mid-Term Evaluation (MTE), see next section). The MTR will be based on project progress reports, on PIRs submitted, visits to regional demonstrations, interviews, etc.. The review will assess the work of the project to date and the likelihood of it achieving anticipated goals and objectives. It will recommend remedial action, revised work plans or management arrangements to improve its effectiveness and likely impact.

2.2.2 Mid-Term Evaluation
If a MTE is deemed necessary it will be carried out to assess the progress and effectiveness of the project in its first period of operation. The evaluation, to be carried out by an independent evaluator contracted and managed by the Evaluation Office, will be based on project progress reports, on PIRs submitted, visits to regional demonstrations, interviews, etc.. The evaluation will assess the work of the project to date and the likelihood of it achieving anticipated goals and objectives. It will

recommend remedial action, revised work plans or management arrangements to improve its effectiveness and likely impact.

2.2.3 Terminal Evaluation

The Evaluation Office will be responsible for the Terminal Evaluation (TE) and will liaise with the Task Manager and Executing Agency(ies) throughout the process. The TE will provide an independent assessment of project performance (in terms of relevance, effectiveness and efficiency), and determine the likelihood of impact and sustainability. It will have two primary purposes: (i) to provide evidence of results to meet accountability requirements, and (ii) to promote learning, feedback, and knowledge sharing through results and lessons learned among UNEP, the GEF, executing partners and other stakeholders. The direct costs of the evaluation will be charged against the project evaluation budget. The Terminal Evaluation will be initiated no earlier than six months prior to the operational completion of project activities and, if a follow-on phase of the project is envisaged, should be completed prior to completion of the project and the submission of the follow-on proposal. Terminal Evaluations must be initiated no later than six months after operational completion.

The draft TE report will be sent by the Evaluation Office to project stakeholders for comments. Formal comments on the report will be shared by the Evaluation Office in an open and transparent manner. The project performance will be assessed against standard evaluation criteria using a six point rating scheme. The final determination of project ratings will be made by the Evaluation Office when the report is finalised and further reviewed by the GEF Independent Evaluation Office upon submission. The evaluation report will be publicly disclosed and may be followed by a recommendation compliance process.The standard terms of reference for the terminal evaluation are included in Appendix 9. These will be adjusted to the special needs of the project.

2.3 Audit Clause

The partner executing agencies will provide UNEP with quarterly financial reports as well as certified annual financial statements with an audit of the financial statements relating to the status of UNEP (including GEF) funds according to the established procedures to be set out in the project document. The Audit will be conducted by the legally recognized auditor, or by a commercial auditor.

2.4 Learning and Knowledge Sharing

Results from the project will be disseminated within and beyond the demonstration areas through a number of existing information sharing networks including GEF IW:LEARN and forums. In addition:

- The project will participate, as relevant and appropriate, in UNEP/GEF sponsored networks, organized for Senior Personnel working on projects that share common characteristics; and
- The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation though lessons learned.

The project will identify, analyse, and share lessons learned that might be beneficial in the design and implementation of similar future projects. Identifying and analysing lessons learned is an ongoing process, and the need to communicate such lessons as one of the project's central contributions is a requirement to be delivered not less frequently than once every 12 months. UNEP shall provide a format and assist the project team in categorizing, documenting and reporting on lessons learned. To this end a percentage of project resources will need to be allocated for these activities.

Objectively verifiable indicators shown in the logical framework will be utilized in all evaluations.

3 Key Performance Indicators

Additional details are presented in the M&E Plan below.

Indicator/ Description	Parameters measured	Baseline value	Means of Verification
Component 1 – Tools for understanding & managing the global N cycle			
Guidance on N budgets [P]	4 guidance documents published (2 in Yr 3, 2 in Yr 4)	UNECE Guidance document on National Nitrogen Budgets, Guidance on NUE from UNECE, OECD, ONW, EU-NEP, GPNM with a need to harmonize & understand variants.	Documents available on web portal
Guidance on overall N threat assessment methodology [P]	Guidance document on integrated N threat assessment methodology published (Yr 4)	TBD	Document available on web portal
Guidance on N flux & distribution methods [P]	Guidance document on N flux & distribution methods published (Yr 4)	TBD	Document available on web portal
Valuation of benefits and threats for future nitrogen scenarios [P]	Methodology for linked valuation of multiple nitrogen benefits & threats completed (Yr 3)	TBD	Document available on web portal
Economic & cultural factors helping/ hindering adoption of options explored [P]	Report on the economic & cultural factors helping/ hindering adoption of options completed (Yr 1)	TBD	Document available on web portal

Indicator/ Description	Parameters measured	Baseline value	Means of Verification
Component 2 – Quantification of N flows, threats & benefits			
Database of shared input, model outcomes & access to measurements [P]	Database established (Yr 2)	TBD	Database can be accessed through web portal
Global assessment [P]	Publication of global assessment (Yr 4)	TBD	Assessment available through web portal
Integrating methods measures and good practices [P]	Synthetic N guidance document published and database populated (Yr 4)	TBD	Document and databased accessible through web portal
Synthesis of future programmes and policy options [P]	Report on N policy options (early Yr 4)	TBD	Report available through web portal
Synthesis of GEF experience on N measures [P]	Compendium of knowledge on N actions (early Yr 3)	TBD	Compendium accessible through web portal
Component 3 – Regional demonstration of full Nitrogen approach			
Regional assessment of N flows undertaken in 5 regions [P]	Main N flows quantified by source sector & pathway by end Year 3	Data availability and reports vary by region, some national level reports exist, European level budget from ENA	Reports from C3 Management Group (C3MG)

Indicator/ Description	Parameters measured	Baseline value	Means of Verification
Regional assessment of N benefits/threats and policy priorities undertaken in 5 regions [P]	Key N benefits/threats quantified & regional priorities identified with policymakers & others in 5 regions (Yr 3)	Data availability and reports vary by region, some national level reports exist, European level analysis from ENA	Reports from C3 Management Group
'Top-ten' priority measures for N management identified in 5 regions [P]	N mitigation/management options identifying win-wins & regional priority list of options delivered in 5 regions by end of Year 3	TBD	Reports from C3 Management Group
Synthesis published on regional experiences in improving N management [P]	Synthesis on regional experiences developed and agreed	TBD	Synthesis published on the regional experiences in improving N management
Consensus on benchmarking N indicators for different regions and systems achieved [P]	Contributions to joint report on regional perspectives for benchmarking N indicators delivered (by end Yr 3)	TBD	Report from C3 Management Group
Rationale and approach for INMS regional demonstration developed [P]	Briefing document on rationale and approach for INMS regional demonstration delivered	Component 3 annex of Pro-Doc	Briefing document available on web portal
Component 4 – Awareness sharing and knowledge raising			
INMS web portal established and populated [P]	5 'areas' of web portal established (i.e. home, project info, news, events, documents), members section established (Yr 1).	The web portal will be purpose built.	Viewable online
Training plan developed [P]	First draft of training plan developed (Yr 1), outlining planned materials and workshops including N footprinting and MOOC	N-footprint calculators are available for a number of countries	Document posted online

Indicator/ Description	Parameters measured	Baseline value	Means of Verification
INMS Key Messages Disseminated [P]	5 Key Messages agreed and communicated (Yr 4), e.g. through Global Assessment	TBD	Key Messages published, e.g. in Global Assessment document
Guidance Documents Published [P]	3 guidance documents published (Yr 4)	Guidance exists for some components and sectors	Guidance documents posted online and published
Participate in IW Conferences [P]	Participation at 2 IW Conferences (Yrs 2 & 4)	TBD	Meeting reports
Project Management			
PCU reports completed on time [P]	Date of reports	0	PMB minutes
PMB held according to schedule [P]	Date of meetings	0	PMB minutes
Sub-Projects completed on time [P]	Completion dates	0	PMB minutes
Financial management [P]	Financial audits	0	PMB minutes UNEP financial reports
Exit Strategy approved and implemented [P]	Approval of Exit Strategy Implementation	0	PMB minutes

4 Monitoring and Evaluation Plan

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Project Objective: To improve the understanding of the global/region N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems				
Component 1: Tools for understanding & managing the global N cycle				
Activity 1.1 Development of National N budget approaches				
Task 1.1.1 Development of National N budget approaches	Guidance Document on National Nitrogen budgets available and accepted.	UNECE Guidance document on National Nitrogen Budgets.	Two meetings held to develop material.	Guidance Document on National Nitrogen budgets delivered.
Task 1.1.2 Development of Farm N budgets	Guidance Document on Farm N budgets available and accepted.	TBD	Two meetings held to develop material.	Guidance Document on Farm N budgets delivered
Task 1.1.3 Development of NUE approaches	Guidance Document on NUE methodology for different purposes available and accepted	Guidance on NUE from UNECE, OECD, ONW, EU-NEP, GPNM with a need to harmonize & understand variants.	Two meetings held to develop material. One initial report published.	Guidance Document on NUE methodology for different purposes delivered
Task 1.1.4 Relating of Level & Effect Indicators to budget indicators	Guidance Document on relating Level & Effect indicators to budget indicators available and accepted	TBD	One meeting held to develop material, one initial report delivered.	Guidance Document on relating Level & Effect indicators to budget indicators delivered
Activity 1.2 Development of threat assessment methodology				
Task 1.2.1 Initial identification of Key Nitrogen Threats	Consultation document on key N threats and criteria for policy & other stakeholders available	TBD	Consultation document available and distributed	Consultation document available and distributed
Task 1.2.2 Conduct stakeholder review & refine N key threats & criteria	Summary of stakeholder feedback and revised set of key N threats and criteria available and accepted	TBD	Summary document completed and revised set of key N threats and criteria documented	Summary document delivered and revised set of key N threats and criteria documented

Task 1.2.3 Workshop(s) to review assessment methodologies for different N threats	Workshops on N threat assessment methodologies with synthesis on links held	TBD	Workshop report(s) on N threat assessment methodologies with synthesis on links	Workshop report(s) on N threat assessment methodologies with synthesis on links
Task 1.2.4 Drafting guidance on overall N threat assessment methodology	Guidance Document on integrated N threat assessment methodology & compendium of primary documents available and accepted	TBD	[This Task starts in Yr3]	Guidance Document on integrated N threat assessment methodology & compendium of primary documents delivered
Activity 1.3 Development of methodology for N fluxes and distribution				
Task 1.3.1 Scoping of N flux and distribution methods (air, land, water, marine, trade)	Scoping report on N flux & distribution methods (air, land, water, marine, trade) available and accepted	TBD	Scoping report on N flux & distribution methods (air, land, water, marine, trade) delivered.	Scoping report on N flux & distribution methods (air, land, water, marine, trade) delivered.
Task 1.3.2 Conduct reviews of N flux and distribution methods for environ. compartments	Background Documents on N flux and distribution methods (to support workshop) available and accepted	TBD	Background Documents on N flux and distribution methods delivered to support workshop	Background Documents on N flux and distribution methods delivered to support workshop
Task 1.3.3 Workshop on harmonizing methodologies for key N fluxes and distribution	Workshop held on methods for N fluxes & distribution with synthesis	TBD	Workshop concept established including securing authors for background documents	Workshop report(s) on methods for N fluxes & distribution with synthesis delivered
Task 1.3.4 Preparing guidance on N flux & distribution methods, plus international support	Guidance Documents on N flux and distribution methods with compendium of primary documents available and accepted	TBD	[This Task starts in Yr3]	Guidance Documents on N flux and distribution methods with compendium of primary documents delivered.
Activity 1.4 Development of approaches for N threat-benefit valuation				
Task 1.4.1 Review of existing threat benefit valuation studies	Status report on N threat benefit valuation identifying key gaps & challenges available and accepted	TBD	Status report on N threat benefit valuation identifying key gaps & challenges delivered	Status report on N threat benefit valuation identifying key gaps & challenges delivered

Task 1.4.2 Refinement of threat benefit valuation across contrasting economies	INMS briefing note summarising main principles of threat-benefit valuation conducted across contrasting economies available and accepted	TBD	INMS briefing note summarising main principles of threat-benefit valuation conducted across contrasting economies delivered	INMS briefing note summarising main principles of threat-benefit valuation conducted across contrasting economies delivered
Task 1.4.3 Integration of food, health, ecosystem, climate & energy benefits & threats	Methodology for linked valuation of multiple nitrogen benefits & threats available and accepted	TBD	Report from meeting to develop methodology for linked valuation of multiple nitrogen benefits & threats delivered	Methodology for linked valuation of multiple nitrogen benefits & threats delivered
Task 1.4.4 Valuation of threats & benefits under future nitrogen scenarios	Document on valuation of benefits and threats for future nitrogen scenarios available and accepted	TBD	[This Task does not start until Year 3]	Document on valuation of benefits and threats for future nitrogen scenarios delivered
Activity 1.5 Flux-impact path models for assessment, scenarios & strategy evaluation				
Task 1.5.1 Translation of storylines & scenarios into defined modelling requirements	INMS working document summarising the INMS modelling strategy including proposed approach to storylines and scenarios available and accepted	TBD	INMS working document summarising the INMS modelling strategy delivered	INMS working document summarising the INMS modelling strategy delivered
Task 1.5.2 Review of component models, criteria, data needs, information flow & outputs	Document on component models, data, info flow & outputs available including links to the INMS models database	TBD	Special report on component models, data, info flow & outputs delivered	Special report on component models, data, info flow & outputs delivered
Task 1.5.3 Design of model framework in relation to storylines, measures and indicators	Document on criteria & necessary components for integrated N modelling cluster available and accepted	TBD	Document on criteria & necessary components for integrated N modelling cluster delivered	Document on criteria & necessary components for integrated N modelling cluster delivered
Task 1.5.4 Application of selected component models in N model cluster	Demonstrated output for model cluster, linking N flows & effects global & regional	TBD	Meeting to plan the model cluster work	Report on INMS model cluster activities delivered
Task 1.5.5 Application of N model cluster for key scenarios at global/regional scales	Report on N flux/pathway modelling approach for global/regional scenarios available and accepted	TBD	[This Task does not start until Year 3]	Report on results from the application of the INMS model cluster for a selection of cases delivered to Component 2.
Activity 1.6 Examination of the barriers achieving to better nitrogen management				
Task 1.6.1 Examination of economic, cultural & other factors that affect adoption of measures	Report on the economic & cultural factors helping/ hindering adoption of	TBD	Report on the economic & cultural factors helping/	Report on the economic & cultural factors helping/

	options available and accepted		hindering adoption of options delivered	hindering adoption of options delivered
Task 1.6.2 Global/regional examination of N barriers to change in food systems	Report on global/regional barriers to better N management in the food system available and accepted	TBD	Report from meeting on global/regional barriers to better N management in the food system delivered	Report on global/regional barriers to better N management in the food system delivered
Task 1.6.3 Global/regional examination of N barriers to change in consumption-production	Report on N barriers for global/ regional consumption-production available and accepted	TBD	Report from meeting on N barriers for global/ regional consumption-production delivered	Report on N barriers for global/ regional consumption-production delivered
Task 1.6.4 Exploration of options to overcome barriers including the role of a full N approach	Report informing global analysis & regional demos on overcoming barriers to change available and accepted	TBD	[This Task does not start until Yr3]	Report informing global analysis & regional demos on overcoming barriers to change delivered
Project objective Outcomes & Outputs	**Description of indicator**	**Baseline level**	**Mid-term target**	**End-of-project target**
Component 2: Quantification of N flows, threats & benefits				
Activity 2.1 Quantifying N flows, threats and benefits at global and regional scales				
Task 2.1.1 Database of shared input, model outcomes & access to measurements	Database established & populated, common datasets, results & access to sources	TBD	Report from workshop held to establish needs of the INMS database(s) Documentation on INMS data completed (INMS databases and links to other data holdings)	Report from workshop held to establish needs of the INMS database(s) Documentation on INMS data completed (INMS databases and links to other data holdings)
Task 2.1.2 International support to regional inventories & model application	Regional demonstrations supported with inventory expertise and models	TBD	Report on first call for supporting activities delivered	Report on all calls for supporting activities delivered
Task 2.1.3 Combined analysis of present N flows and impacts at global and regional scales	Report with data shared on global & regional N flows , threats & benefits available and accepted	TBD	Report from workshop on global & regional N flows, threats & benefits delivered.	Report with data shared on global & regional N flows , threats & benefits delivered
Task 2.1.4 Quantifying present & future N threats & benefits at global and regional scales	Report comparing present situation with future scenarios of benefits and threats available and accepted	TBD	Reports from meetings held to compare present situation with future scenarios of benefits and threats delivered	Report comparing present situation with future scenarios of benefits and threats delivered

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Activity 2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations				
Task 2.2.1 Preparation of scope & structure of consolidated global assessment	Scope & outline structure of global assessment of N fluxes, pathways & impacts available and agreed	TBD	Scope & outline structure of global assessment of N fluxes, pathways & impacts delivered	Scope & outline structure of global assessment of N fluxes, pathways & impacts delivered
Task 2.2.2 Commissioning of author teams and preparation of the consolidated overview	Authors appointed and outline chapter drafts available and agreed	TBD	Report from one workshop on appointing authors and scoping outlines for chapter drafts	Report to PPA on appointed authors
Task 2.2.3 Peer review of chapters in the global assessment & revision	Peer review of chapters in the global assessment & revision achieved	TBD	[This Task starts in yr 3]	Report to PPA on peer review process for Global Assessment
Task 2.2.4 Preparation of summary docs & review with workshop	Documents reviewed by PPA, SPAG & other stakeholders	TBD	[This Task starts in yr 3]	Report from review workshop
Task 2.2.5 Publishing & distribution of consolidated assessment	Published report with wide public dissemination	TBD	[This Task starts in yr 4]	Report published in hardcopy, launch held.
Activity 2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr				
Task 2.3.1 Preparation of documents on state of the art for N good practices (N form, N effects etc)	Background documents produced & available at workshop	TBD	Background documents delivered	Background documents delivered
Task 2.3.2 Workshop to link methods & good practices for N effects (food, water, air, climate etc)	Basis for developing guidance linking N forms & issues, high-lighting most promising options available and accepted	TBD	Report from workshop on developing guidance linking N forms & issues, high-lighting most promising options delivered	Report from workshop on developing guidance linking N forms & issues, high-lighting most promising options delivered
Task 2.3.3 Publishing of revised papers and preparation of synthetic guidance document	First draft of guidance doc synthesized for wide review available and accepted	TBD	Skeleton version of draft guidance document developed from T2.3.2 workshop report	First draft of guidance doc synthesized for wide review delivered
Task 2.3.4 Peer and Stakeholder review of Synthetic N guidance document	Text of consolidated guidance document available and accepted	TBD	[This Task starts in Yr3]	Finalized text of consolidated guidance document delivered

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 2.3.5 Publishing of synthesis doc & updating of practice database	Consolidated methods/practice report available and accepted & database published	TBD	[This Task starts in Yr4]	Consolidated methods/practice report delivered & database populated
Activity 2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis				
Task 2.4.1 Review of existing N policies for different countries & regions	Database and report on N policies, storylines & scenarios available	TBD	Database populated and report on N policies, storylines & scenarios delivered	Database populated and report on N policies, storylines & scenarios delivered
Task 2.4.2 Review of existing storylines and scenarios relevant for N	Background document on N policies & scenarios available and accepted	TBD	Background document on N policies & scenarios delivered	Background document on N policies & scenarios delivered
Task 2.4.3 Workshop on N storylines & scenarios for shared use across the project	Strategy for N storylines and scenarios available and accepted	TBD	Strategy for N storylines and scenarios delivered	Strategy for N storylines and scenarios delivered
Task 2.4.4 Synthesis of future programmes and policy options supported by cost benefit analysis	Report on N policy options & their possible contribution to the Green Economy available and accepted	TBD	Agenda for planned document development meeting agreed	Report on N policy options & their possible contribution to the Green Economy delivered
Activity 2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr				
Task 2.5.1 Review of N measures adopted by GEF and incorporation into database	Database and summary document on GEF N measures available and accepted	TBD	Database populated and summary report on GEF N Measures delivered	Database populated and summary report on GEF N Measures delivered
Task 2.5.2 Review of N measures adopted by others inc from INMS demo regions & inc in database	Database and summary document on N measures adopted by others available and accepted	TBD	Database populated and summary report on N Measures (including Non- GEF measures) delivered	Database populated and summary report on N Measures (including Non- GEF measures) delivered
Task 2.5.3 Preparation of compendium of knowledge on N actions implemented by GEF & others	Synthesis supported by data-base on N actions as contrib. to global assessment available and accepted	TBD	Verbal report to annual project meeting on developing a compendium of N actions and updates to database	Synthesis supported by database on N actions delivered
Component 3: Regional demonstration of Full Nitrogen Approach				
Project objective Outcomes & Outputs	**Description of indicator**	**Baseline level**	**Mid-term target**	**End-of-project target**

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Activity 3.1 Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.				
Tasks 3.1.1 & 3.1.2 Examination of N flows by source sector & loss pathway; inc improving access to data	Main N flows quantified by source sector & pathway; better data access & understanding for 5 regions by end Year 3.	TBD	Reports from meetings to quantify main N flows, facilitate better data access and understanding for 5 regions.	Reports from meetings to quantify main N flows, facilitate better data access and understanding for 5 regions.
Task 3.1.3 Identifying & quantifying major uncertainties and means to improve	Quantification of major N source sectors with estimated uncertainties for 5 regions by end Year 3.	TBD	Reports to demonstration management board meetings on quantification of major N source sectors with estimated uncertainties for 5 regions.	Reports to demonstration management board meetings on quantification of major N source sectors with estimated uncertainties for 5 regions.
Tasks 3.1.4 & 3.1.5 Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	Key N benefits/threats quantified & regional priorities identified with policymakers & others in 5 regions	TBD	Report from initial meeting to identify key N benefits/threats in 5 regions Agenda available for policymaker workshop to quantify key N benefits/threats & regional priorities in 5 regions	Report from policymaker workshop to quantify key N benefits/threats & regional priorities in 5 regions, delivered
Task 3.1.6 Description in relation to N performance indicators, in co-operation with global analysis	Basis to compare regions in relation to agreed performance indicators for 5 regions available and agreed	TBD	Agenda available for workshop to develop basis for comparing regions in relation to agreed performance indicators	Report on Basis to compare regions in relation to agreed performance indicators for 5 regions delivered
Task 3.1.7 Review of available options for mitigation/better N management, co-benefits/trade-offs	Document on N mitigation/management options identifying win-wins & regional priority list of options available and agreed for 5 regions	TBD	Agenda available for workshop, including draft 'Top 10' priority measures for improved N management, for each regional demo.	Document on N mitigation/management options identifying win-wins & regional priority list of options available and agreed for 5 regions delivered
Task 3.1.8 Profiling success stories, barriers to change, and demonstration of N joined up approach	Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers available and agreed	TBD	Agenda for workshop to develop synthesis of benefits of a 'full N approach' for 5 regions available	Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers for 5 regions, delivered

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 3.1.9 Contribution to scenario development in cooperation with global analysis	Global N scenarios informed by evidence from the regional demonstrations	TBD	Reports from 2 demonstration management board meetings to review proposals for scenario development, for 5 regions, to ensure fit for purpose.	Report from management board meetings confirming scenarios fit for purpose, for 5 regions, delivered
Activity 3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits				
Task 3.2.1 Preparation of scope, agenda and workshop, with documentation in coop with global framing	Advance background documents for each regional demo according to a common template available	TBD	Common template for background documents, delivered	Advance background documents for each regional demo delivered
Task 3.2.2 Hosting of workshop bringing together regional demos in cooperation with global partners	Basis for preparing synthesis publication on shared lessons from the regional demonstrations	TBD	[This Task starts in Yr 3]	Report from workshop on preparing synthesis publication on shared lessons from the regional demonstrations delivered
Task 3.2.3 Peer review and publication of the synthesis document	Authoritative synthesis published on the regional experiences in improving N management	TBD	[This Task starts in Yr 3]	Synthesis published on the regional experiences in improving N management
Activity 3.3 Building consensus on benchmarking N indicators for different regions and systems				
Task 3.3.1 Regional contribution to scoping paper in cooperation with A1.1	Scoping paper on benchmarking N indicators informed with regional perspectives available and agreed	TBD	First draft of regional contribution to scoping paper in cooperation with A1.1, for 5 regions delivered	Documents on regional perspectives delivered to A1.1.
Task 3.3.2 Regional attendance at INMS workshop sessions with focus on indicator benchmarking	Joint report informed with regional perspectives on benchmarking N indicators	TBD	Regional attendance from all 5 regions at INMS workshop sessions with focus on indicator benchmarking	Contributions to joint report on regional perspectives for benchmarking N indicators delivered
Activity 3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management				
Task 3.4.1 Preparation of briefing on rationale and approach for INMS regional demonstration	Briefing document available for testing with stakeholders	TBD	Briefing document delivered	Briefing document delivered

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 3.4.2 Revision of regional approach using stakeholder feedback and considering regional priorities	Revised briefing document on common approach accounting for regional priorities	TBD	Reports from 2 workshops to revise common approach	Reports from 3 workshops to revise common approach
Task 3.4.3 Engagement and dissemination of the INMS approach to regional N cycle assessment	Recognition of INMS N cycle approach with GPA & other international frameworks	TBD	[This Task starts in Yr 3]	Report on wider engagement activities in showing the role of regional information in nitrogen cycle assessment
Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Component 4: Awareness raising & knowledge sharing				
Activity 4.1 Establishment and operation of INMS communications hub (including portal, database, communications, public engagement)				
Task 4.1.1 Establishment, population & operation of INMS web portal	INMS web portal established and populated	TBD	INMS web portal is fully functional with dedicated content for partners, public, press	INMS web portal populated with all project reports, public engagement and training materials
Task 4.1.2 Establishment & maintenance of INMS database including links to other data sources	INMS database established and populated	TBD	INMS database ready for both upload and download of data, online guidance completed	INMS database populated and fully documented
Task 4.1.3 Develop communications function for INMS partners	Regular information provided to partners, through web portal, newsletters etc	TBD	Partner contact lists fully established. Inception meeting (1st Project Partners Assembly) and 2nd and 3rd Project Partners Assembly meetings held. Partner content fully visible on web portal 4 newsletters disseminated	Partner contact lists fully established. 4th and 5th (final) Project Partners Assembly meetings held. Partner content fully visible on web portal 8 newsletters disseminated

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 4.1.4 Develop press and public engagement function for INMS	Press and public engagement strategy developed. Audience specific products for press and public developed Network of nitrogen champions developed	TBD	Press and public engagement strategy developed Web portal updated with press specific content and public engagement items Five nitrogen champions recruited and trained, nitrogen champion specific materials uploaded to web portal.	Post project press and public engagement strategy developed Web portal updated with 4 press releases and 4 engagement products (infographics/ audio/video) 15 nitrogen champions recruited and trained, nitrogen champion specific materials uploaded to web portal.
Activity 4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting				
Task 4.2.1 Training in nitrogen measurement, modelling and mitigation techniques	Training plan developed, trainings attended, training materials available	0	Training plan developed 1 training item added to the web portal	Post project training strategy developed 3 training items added to the web portal 1 training event held INMS contribution to Nitrogen MOOC completed
Task 4.2.2 International engagement of the project to foster better understanding of N challenges	Meetings attended, discussions of INMS held by country representatives and at meetings of intergovernmental processes	Contacts regularly attend meetings of the UNECE and GPA/UNEP and OECD	INMS discussed at 1 meeting of an intergovernmental process INMS mentioned in 1 country level report	INMS discussed at 3 meetings of an intergovernmental process INMS mentioned in 3 country level reports
Task 4.2.3 Share experiences on N foot-printing as a means of developing public awareness	Workshop attended, further N footprinting tools developed	N-Calculators in existence in United States, Netherlands, Germany & United Kingdom. Versions for Austria, Japan, Australia, China, Denmark and Tanzania are in development.	Workshop on N Footprinting held, plans for further development agreed	Experiences with N Footprinting and further developments documented, new materials available online

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Activity 4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & development of long-term strategy				
Task 4.3.1 Development of synthesis to demonstrate INMS in support of GPA objectives	Key messages developed and visible. Guidance documents published and disseminated INMS Project Partner Assemblies held, with stakeholder interaction Events held jointly with intergovernmental processes and conferences	TBD	Emerging messages document developed Guidance document timeline developed 3 Project Partners Assemblies held, with associated stakeholder engagement 1 event held jointly with intergovernmental processes INMS contributes to 1 UNEA and 1 IW conference	5 Key Messages on INMS agreed and disseminated 3 guidance documents developed (as for OP4.5) 5 Project Partners Assemblies held, with associated stakeholder engagement 2 events held jointly with intergovernmental processes INMS contributes to 2 UNEA and 2 IW conferences
Task 4.4.1 Coordination of INMS inputs to other policy processes	Harmonised messages emerging from the project, opportunities for 'policy intervention points' taken, Nitrogen champions developed and deployed with relevant messages	A number of partners within the project have regular contact at national, regional and global policy levels, for example UNEP/GPA, UNECE, OECD.	Emerging messages discussed at 3rd Project Partners Assembly Policy intervention strategy developed 3 nitrogen champions of relevance to policy processes recruited and trained	5 key messages relevant to policy processes agreed and disseminated 3 policy intervention activities completed and documented 5 nitrogen champions of relevance to policy processes recruited and trained
Task 4.4.2 Development of a long-term strategy for INMS, inc. policy homes & financing models	Long-term strategy for INMS documented and communicated, including financing models	Initial Review of N Policy Homes. Discussions on 'Policy Arena for Nitrogen', held at INMS Lisbon meeting	First draft of long-term INMS strategy completed, including a list of finance models for further investigation	Final draft of long-term INMS strategy published and disseminated, including a range of costed finance models
Activity 4.5 Harmonization, publication & dissemination of guidance documents across components				
Task 4.5.1 Harmonization & publication of guidance on N budgets, efficiency & benchmarking	Publication of guidance document, common style and approach visible	TBD	Draft guidance publication strategy developed, considering timing, messages, and linkages to intergovernmental processes	Guidance document published and disseminated

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 4.5.2 Harmonization and publication of guidance on threats, fluxes & distribution methods	Publication of guidance document, common style and approach visible	TBD	Draft guidance publication strategy developed, considering timing, messages, and linkages to intergovernmental processes	Guidance document published and disseminated
Task 4.5.3 Harmonization & publication on N measures and good practices inc. barriers and successes	Publication of guidance document, common style and approach visible	TBD	Draft guidance publication strategy developed, considering timing, messages, and linkages to intergovernmental processes	Guidance document published and disseminated
Activity 4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP				
Task 4.6.1 Provide 1% of project resources to support IW:LEARN	Participation in IW Conferences	0	Participate in 1 IW Conference	Participate in 2 IW Conferences
Task 4.7.1 Connect INMS website with IW-LEARN & other GEF systems	Number of links made between INMS and IW:LEARN and other IW projects	0	INMS website clearly linked to IW:LEARN	INMS website clearly linked to IW:LEARN
Task 4.8.1 Cooperate with IW-LEARN and STAP inc. development of a N Community of Practice (CoP).	Visible Nitrogen CoP on the INMS web portal	TBD	Nitrogen CoP site established on INMS web portal and populated	Nitrogen CoP site established on INMS web portal and populated
Task 4.9.1 Participate in Int. Waters Conferences and prepare INMS Experience Notes	Participation in IW Conferences, experience notes visible	TBD	Participate in 1 IW Conference 1 experience note uploaded onto INMS web portal	Participate in 2 IW Conferences 3 experience notes uploaded onto INMS web portal

5 M&E Financing

The total amount of Co-financing for M&E of the GEF INMS Project is $43,200. This amount represents funds dispersed on baseline activities, data and information gathering in support of the various reports and funds expected to be dispersed on M&E related activities during the course of the project.

Monitoring and Evaluation	
Funding source	**Co-financing ($)**
GEF Financing	224,500
Co-financing	165,000
Total	**389,500**

5.1 M&E summary budget

The budget for monitoring and evaluation of the project is summarized in the table below and comprises the costs allocated to M&E for external review, management at component level and activities of the PCU.

Monitoring and Evaluation							
Budget Item	**Total GEF Funding**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Co-financing/Counterpart**	**Total**
Consultant (M&E: Midterm and Terminal Evaluations)	50,000		20,000		30,000	0	50,000
Periodic Component Level Reports, including attendance and travel to PMB meetings and Inception meeting [30% Component level management budget]	109,500	27,375	27,375	27,375	27,375	100,000	209,500

PCU periodic reporting	40,000	10,000	10,000	10,000	10,000	40,000	80,000
PCU travel	20,000	5,000	5,000	5,000	5,000	20,000	40,000
Communications	5,000	1,250	1,250	1,250	1,250	5,000	10,000
Total							**389,500**

*The final amount will depend on the partners involved in Component Leadership roles, which will be formalized at the inception meeting.

6 Indicative M&E activities and responsibilities

Type of M&E activity	Responsible Parties	GEF Budget US$	Time frame
Project Management Board & Project Partners Assembly Inception Workshops	▪ Project Coordinator ▪ PCU ▪ PMG ▪ UNEP Task Manager ▪ Project Partners Assembly provide endorsement	38,000	1st PMG and PPA Meetings will serve as Inception workshop and will be held within first four months of project start up.
Inception Report	▪ Project Coordinator ▪ PCU ▪ PMB ▪ UNEP Task Manager ▪ Project Partners Assembly provide endorsement	None	Immediately following inception workshop
Measurement of indicators set in the Project Results Framework (Project Progress and Performance to be measured	▪ UNEP Task Manager ▪ Project Coordinator in collaboration with PCU	None	Annually prior to APR/PIR and to the definition of annual work plans

on an annual basis)			
APR and PIR	▪ Project Coordinator & PCU ▪ UNEP Task Manager ▪ PMB	None	Annually
Periodic status reports	▪ PCU	None	To be determined by PCU, UNEP and EAs
Technical reports/Project publications	▪ For previously agreed reports: Component, Activity and Task Leaders as appropriate ▪ For new reports: PMB, Component, Activity & Task Leaders, Hired consultants as needed	95,950	To be determined by Project Team, UNEP and PCU, EA
Mid-Term Review	▪ Project Coordinator & PCU ▪ UNEP Task Manager ▪ Project Partners Assembly provide endorsement ▪ External consultant	20,000	Halfway through project cycle
Terminal External Evaluation	▪ Evaluation Team ▪ PCU ▪ UNEP Task Manager ▪ Project Partners Assembly provide endorsement ▪ External Consultants	30,000	At the end of project implementatio n
Terminal Report	▪ PCU ▪ PMB ▪ UNEP Task Manager	38,000	At least one month before the end of the project

	▪ Project Partners Assembly provide endorsement ▪ External Consultant*		
Lessons learned	▪ PCU ▪ UNEP Task Manager ▪ Partner executing agencies*	None	Yearly as part of the APR
Audit	▪ UNEP Task Manager ▪ PCU ▪ EA accredited Auditor	4,000	Yearly
TOTAL indicative COST		USD 224,500	

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 08

Summary of Reporting Requirements and Responsibilities

Table of Contents

1 Background

This appendix provides information on the organisational groupings within the project and their respective responsibilities in terms of both monitoring, activity reporting and financial reporting. Table A8.1 provides a list of responsibilities by group and outlines the agencies and officers involved to Component and demonstration activity level. Table A8.2 provides further detail on the agencies and officers with responsibilities at Activity and Task level. Table A8.3 provides further information on each group involved in the evaluation process.

2 Tables

Follow on the next pages.

Table A8.1

INSTITUTION/AGENCY	PROJECT/ AGENCY OFFICER	RESPONSIBILITIES	MEANS OF ASSESSMENT/ MONITORING DATA SOURCE
Project Coordination Unit: INI (NERC)	Project Coordinator	Preparation of the Overall Work Plan, time-tables, budgets, risk & indicator tables Integration and editing of quarterly component reports Preparation of overall progress reports Preparation of expenditure statements (including co-financing)	Project Document, Implementing & Executing Agency inputs, Reports of Project Management Board, Stakeholder and Policy Advisory Group and Project Partners Assembly
Project Management Board (PMB): Implementing Agency (UNEP), Executing Agency (INI), Component Leaders	Project Coordinator (secretariat)	Monitoring of project operations and component level coordination, including operational decision making	
Stakeholder & Policy Advisory Group (SPAG): stakeholder partners, policy representatives and independent experts	Project Coordinator (secretariat)	Sharing of international perspectives and provision of advice	
Project Partners Assembly (PPA): All project partners	Project Coordinator (secretariat)	Strategic monitoring of overall work- plan by full project partnership	
Component Coordination Units: C1: INI North America (USGS/University of Colorado) & INI Europe (PBL) C2: INI Europe (WUR) & INI Latin America (INPE) C3: INI / PCU (NERC-CEH) & INI Africa (IITA) C4: INI / PCU (NERC-CEH & PBL)	*Component Leaders / Focal Points:* C1: Jill Baron (USGS/Univ Colorado), INI North America Director & Hans van Grinsven (PBL), INI Europe Centre C2: Wim de Vries (WUR), INI Europe Centre & Jean Ometto (INPE), INI Latin American Director C3: Mark Sutton (NERC), INI Chair & Cargele Masso (IITA), INI Africa Director C4: INI / PCU: Clare Howard (NERC), Albert Bleeker (PBL)	Overall supervision and monitoring of Component Activities Integration and editing of component reports Preparation of expenditure statements (including co-financing)	Project Documents Reports of Component Co-ordination Units to PMB to PCU

Table A8.1			
INSTITUTION/AGENCY	**PROJECT/ AGENCY OFFICER**	**RESPONSIBILITIES**	**MEANS OF ASSESSMENT/ MONITORING** **DATA SOURCE**
C3: East Asia Demonstration: INI East Asia (Chinese Academy of Sciences, Institute of Soil Science) and Kentaro Hyashi (NIAES, Japan). C3: South Asia Demonstration: INI South Asia (Society for the Conservation of Nature, SCON / Indian Nitrogen Group) C3: Latin America Demonstration: INI Latin America (INPE) C3: East Africa Demonstration: INI Africa (IITA) C3: East Europe Demonstration: INI Europe / TFRN (NAAS and University of Odessa) C3: West Europe Demonstration: INI Europe / TFRN (UPMC)	C3, East Asia: Xiaoyuan Yan (Chinese Academy of Science, Institute of Soil Science), & Kentaro Hyashi (NIAES), INI East Asia Centre. C3, South Asia: Tapan Adhya (Univ. Bubaneshwar) INI South Asia Director and N. Raghuram (IPU University) former INI South Asia Director. C3, Latin America: Jean Ometto (INPE) INI Latin America Director. C3, East Africa: Cargele Masso (IITA), INI Africa Director C3, East Europe: Lidiya Molychuk (NAAS), TFRN; Serge Medinets (University of Odessa), TFRN C3: West Europe: Josette Garnier (UPMC), INI European Centre.	On-site supervision of demonstration activities Integration and editing of demonstration activity reports	Project Documents Reports of Regional Demonstration Committees to PMB to PCU
Activity Co-ordination Units (C1,2,4)	See Table 8.2 for full list of agencies and officers.	Overall supervision and monitoring at activity level Integration and editing of activity level reports	Reports to Component Co-ordination Units to PMB to PCU
Task Co-ordination Units (C1, 2, 4) (C3, T3.2-3.4)	See Table A8.2 for full list of agencies and officers.	Overall supervision and monitoring at task level Integration and editing of task level reports	Reports to Component Co-ordination Units to PMB to PCU
Partners	See Table 7 in the Project Document, for a full list of partners.	Counterpart contribution reports.	Reports to PCU

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
C1: Component Committee on Tools & Methods for N cycle		
Activity 1.1 Development of N system indicators	INI Europe INI North America	Wilfried Winiwarter (IIASA) Jill Baron (USGS)
Task 1.1.1 Development of National N budget approaches	INI Europe Japanese Nitrogen Expert Group	Wilfried Winiwarter (IIASA) Kentaro Hayashi (NIAES)
Task 1.1.2 Development of Farm N budgets	INI TFRN	Cameron Gourley (DPI Victoria,Australia) Tom Misselbrook (BBSRC)
Task 1.1.3 Development of NUE approaches	EU-NEP and TFRN	Oene Oenema (WUR, Netherlands)
Task 1.1.4 Relating level and effect indicators to budget indicators	INI North America INI Europe	Jill Baron (USGS) Wilfried Winiwarter (IIASA)
Activity 1.2 Development of Threat Assessment Methodology	INI North America ILTER and INI East Asia	Jill Baron (USGS) Hideake Shibata (ILTER)
Task 1.2.1 Initial identification of key nitrogen threats	INI Europe INI (PCU)	Hans van Grinsven (PBL) Clare Howard (NERC)
Task 1.2.2 Conduct stakeholder review & refine N key threats & criteria	INI North America ILTER and INI East Asia	Jill Baron (USGS) Hideake Shibata (ILTER)
Task 1.2.3 Workshop(s) to review assessment methodologies for different N threats	INI North America ILTER and INI East Asia	Jill Baron (USGS) Hideake Shibata (ILTER)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Task 1.2.4 Drafting guidance on overall N threat assessment methodology	INI North America ILTER and INI East Asia	Jill Baron (USGS) Hideake Shibata (ILTER)
Activity 1.3 Development of methodology for N fluxes and distribution	UNECE Task Force on Measurement Modelling INI (PCU)	Christine Braban (NERC) Mark Sutton (NERC)
Task 1.3.1 Scoping of N flux and distribution methods (air, land, water, marine, trade)	UNECE Task Force on Measurement Modelling INI (PCU)	Christine Braban (NERC) Mark Sutton (NERC)
Task 1.3.2 Conduct reviews of N flux and distribution methods for environ. Compartments	UNECE Task Force on Measurement Modelling INI (PCU)	Christine Braban (NERC) Mark Sutton (NERC)
Task 1.3.3 Workshop on harmonizing methodologies for key N fluxes and distribution	UNECE Task Force on Measurement Modelling INI (PCU)	Christine Braban (NERC) Mark Sutton (NERC)
Task 1.3.4 Preparing guidance on N flux & distribution methods, plus international support	UNECE Task Force on Measurement Modelling INI (PCU)	Christine Braban (NERC) Mark Sutton (NERC)
Activity 1.4 **Development of approaches for N threat-benefit valuation**	INI Europe INI East Asia	Hans van Grinsven (PBL) Baojing Gu (University of Zhejiang)
Task 1.4.1 Review of existing threat benefit valuation studies	INI Europe INI East Asia	Hans van Grinsven (PBL) Baojing Gu (University of Zhejiang)
Task 1.4.2 Refinement of threat benefit valuation across contrasting economies	INI Europe INI East Asia	Hans van Grinsven (PBL) Baojing Gu (University of Zhejiang)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Task 1.4.3 Integration of food, health, ecosystem, climate & energy benefits & threats	INI Europe *INI East Asia*	Hans van Grinsven (PBL) Baojing Gu (University of Zhejiang)
Task 1.4.4 Valuation of threats & benefits under future nitrogen scenarios	INI Europe INI East Asia	Hans van Grinsven (PBL) Baojing Gu (University of Zhejiang)
Activity 1.5 **Flux-impact path models for assessment, scenarios & strategy evaluation**	INI Europe TFRN	Wim de Vries (ALTERRA WUR) Wilfried Winiwarter (IIASA)
Task 1.5.1 Translation of storylines & scenarios into defined modelling requirements	INI Europe TFRN	Wim de Vries (ALTERRA WUR) Wilfried Winiwarter (IIASA)
Task 1.5.2 Review of component models, criteria, data needs, information flow & outputs	INI Europe INI (PCU)	Wim de Vries (ALTERRA WUR) Clare Howard (NERC)
Task 1.5.3 Design of model framework in relation to storylines, measures and indicators	INI Europe TFRN	Wim de Vries (ALTERRA WUR) Wilfried Winiwarter (IIASA)
Task 1.5.4 Application of selected component models in N model cluster	INI Europe TFRN	Wim de Vries (ALTERRA WUR) Wilfried Winiwarter (IIASA)
Task 1.5.5 Application of N model cluster for key scenarios at global/regional scales	INI Europe TFRN	Wim de Vries (ALTERRA WUR) Wilfried Winiwarter (IIASA)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Activity 1.6 **Examination of the barriers achieving to better nitrogen management**	INI Europe INI Africa	Tara Garnett (Oxford Martin School) Cargele Masso (IITA)
Task 1.6.1 Examination of economic, cultural & other factors that affect adoption of measures	INI Europe INI Africa	Tara Garnett (Oxford Martin School) Cargele Masso (IITA)
Task 1.6.2 Global/regional examination of N barriers to change in food systems	INI East Asia African Centre of INI	Baojing Gu (Zhejiang University) Cargele Masso (IITA)
Task 1.6.3 Global/regional examination of N barriers to change in consumption-production	INI Europe INI Europe	Henk Westhoek (PBL) Tara Garnett (Oxford Martin School)
Task 1.6.4 Exploration of options to overcome barriers inc. the role of a full N approach	African Centre of INI INI Europe	Cargele Masso (IITA) Tara Garnett (Oxford Martin School)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Component 2: Regional / global quantification of N use, flows, impacts and the quantitative benefits of applying best management practices		
Activity 2.1 **Quantifying N flows, threats and benefits at global and regional scales**	European Centre of INI North American Centre of INI	Wim de Vries (WUR)
Task 2.1.1 Database of shared input, model outcomes & access to measurements	INI (PCU) INI Latin America	Bill Bealey (NERC) Jean Ometto (CCST-INPE, BR)
Task 2.1.2 International support to regional inventories & model application	INI (PCU) INI Latin America	Clare Howard (NERC) Jean Ometto (CCST-INPE, BR)
Task 2.1.3 Combined analysis of present N flows and impacts at global and regional scales	INI Europe (co-lead tba)	Wim de Vries (WUR, NL) (co-lead tba)
Task 2.1.4 Quantifying present & future N threats & benefits at global and regional scales	INI Europe (co-lead tba)	Wim de Vries (WUR, NL) (co-lead tba)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Activity 2.2 **Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations**	INI (PCU) INI (PCU)	Clare Howard (NERC) Mark Sutton (NERC)
Task 2.2.1 Preparation of scope & structure of consolidated global assessment	INI (PCU) INI (PCU)	Clare Howard (NERC) Mark Sutton (NERC)
Task 2.2.2 Commissioning of author teams and preparation of the consolidated overview	INI (PCU) INI (PCU)	Clare Howard (NERC) Mark Sutton (NERC)
Task 2.2.3 Peer review of chapters in the global assessment & revision	INI (PCU) INI (PCU)	Clare Howard (NERC) Mark Sutton (NERC)
Task 2.2.4 Preparation of summary docs & review with workshop	INI (PCU) INI (PCU)	Clare Howard (NERC) Mark Sutton (NERC)
Task 2.2.5 Publishing & distribution of consolidated assessment	INI (PCU) INI (PCU)	Clare Howard (NERC) Mark Sutton (NERC)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Activity 2.3 **Integrating methods, measures & good practices to address issues of excess & insufficient N_r**	INI European Centre / EU NEP and TFRN (co-lead tba)	Oene Oenema (ALTERRA WUR)
Task 2.3.1 Preparation of documents on state of the art for N good practices (N form, N effects etc)	INI European Centre / EU NEP and TFRN (co-lead tba)	Oene Oenema (ALTERRA WUR)
Task 2.3.2 Workshop to link methods & good practices for N effects (food, water, air, climate etc)	INI European Centre / EU NEP and TFRN (co-lead tba)	Oene Oenema (ALTERRA WUR)
Task 2.3.3 Publishing of revised papers and preparation of synthetic guidance document	INI European Centre / EU NEP and TFRN (co-lead tba)	Oene Oenema (ALTERRA WUR)
Task 2.3.4 Peer and Stakeholder review of Synthetic N guidance document	INI European Centre / EU NEP and TFRN (co-lead tba)	Oene Oenema (ALTERRA WUR)
Task 2.3.5 Publishing of synthesis doc & updating of practice database	INI European Centre / EU NEP and TFRN (co-lead tba)	Oene Oenema (ALTERRA WUR)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Activity 2.4 **Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis**	INI Europe / TFRN INI North America	Wilfried Winiwarter (IIASA) David Kanter (New York University)
Task 2.4.1 Review of existing N policies for different countries & regions	OECD INI North America	Gerard Bonnis (OECD) David Kanter (New York University)
Task 2.4.2 Review of existing storylines and scenarios relevant for N	INI Europe / TFRN INI North America	Wilfried Winiwarter (IIASA) David Kanter (New York University)
Task 2.4.3 Workshop on N storylines & scenarios for shared use across the project	INI Europe / TFRN INI North America	Wilfried Winiwarter (IIASA) David Kanter (New York University)
Task 2.4.4 Synthesis of future programmes and policy options supported by cost benefit analysis	INI Europe / TFRN INI North America	Wilfried Winiwarter (IIASA) David Kanter (New York University)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Activity 2.5 **Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient N_r.**	GNC project / GPNM GNC project / INI	Sara Walker (WRI) Albert Bleeker (PBL)
Task 2.5.1 Review of N measures adopted by GEF and incorporation into database	GNC project / GPNM GNC project / INI	Sara Walker (WRI) Albert Bleeker (PBL)
Task 2.5.2 Review of N measures adopted by others inc from INMS demo regions & inc in database	OECD (co-lead tba)	Gerard Bonnis (OECD) (co-lead tba)
Task 2.5.3 Preparation of compendium of knowledge on N actions implemented by GEF and others	GNC project / GPNM GNC project / INI	Sara Walker (WRI) Albert Bleeker (PBL)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Component 3: Regional demonstration of Full Nitrogen Approach		
Activity 3.1 **Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.**	INI (PCU) Asian Centre of INI	Mark Sutton (NERC) N. Raghuram (ING SCON)
Tasks 3.1.1 & 3.1.2 Examination of N flows by source sector & loss pathway; including improving access to data	See Table A8.1 for the lead person of each regional demonstration.	See Table A8.1 for the lead agencies/officers of each regional demonstration.
Task 3.1.3 Identifying & quantifying major uncertainties and means to improve	See Table A8.1 for the lead person of each regional demonstration.	See Table A8.1 for the lead agencies/officers of each regional demonstration.
Tasks 3.1.4 & 3.1.5 Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	See Table A8.1 for the lead person of each regional demonstration.	See Table A8.1 for the lead agencies/officers of each regional demonstration.
Task 3.1.6 Description in relation to N performance indicators, in co-operation with global analysis	See Table A8.1 for the lead person of each regional demonstration.	See Table A8.1 for the lead agencies/officers of each regional demonstration.
Task 3.1.7 Review of available options for mitigation/better N management, co-benefits/trade-offs	See Table A8.1 for the lead person of each regional demonstration.	See Table A8.1 for the lead agencies/officers of each regional demonstration.

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Task 3.1.8 Profiling success stories, barriers to change, and demonstration of N joined up approach	See Table A8.1 for the lead person of each regional demonstration.	See Table A8.1 for the lead agencies/officers of each regional demonstration.
Task 3.1.9 Contribution to scenario development in cooperation with global analysis	See Table A8.1 for the lead person of each regional demonstration.	See Table A8.1 for the lead agencies/officers of each regional demonstration.
Activity 3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits	INI (PCU) Asian Centre of INI	Mark Sutton (NERC) N. Raghuram (ING SCON)
Task 3.2.1 Preparation of scope, agenda and workshop, with documentation in coop with global framing	INI (PCU) Asian Centre of INI	Mark Sutton (NERC) N. Raghuram (ING SCON)
Task 3.2.2 Hosting of workshop bringing together regional demos in cooperation with global partners	INI (PCU) Asian Centre of INI	Mark Sutton (NERC) N. Raghuram (ING SCON)
Task 3.2.3 Peer review and publication of the synthesis document	INI (PCU) Asian Centre of INI	Mark Sutton (NERC) N. Raghuram (ING SCON)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Activity 3.3 Building consensus on benchmarking N indicators for different regions and systems	INI European Centre / EU NEP INI African Centre	Oene Oenema (ALTERRA WUR) Cargele Masso (IITA)
Task 3.3.1 Regional contribution to scoping paper in cooperation with A1.1	INI European Centre / EU NEP INI African Centre	Oene Oenema (ALTERRA WUR) Cargele Masso (IITA)
Task 3.3.2 Regional attendance at INMS workshop sessions with focus on indicator benchmarking	INI European Centre / EU NEP INI African Centre	Oene Oenema (ALTERRA WUR) Cargele Masso (IITA)
Activity 3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.	INI (PCU) INI (PCU)	Mark Sutton (NERC) Clare Howard (NERC)
Task 3.4.1 Preparation of briefing on rationale and approach for INMS regional demonstration	INI (PCU) INI (PCU)	Mark Sutton (NERC) Clare Howard (NERC)
Task 3.4.2 Revision of regional approach using stakeholder feedback and considering regional priorities	INI (PCU) INI (PCU)	Mark Sutton (NERC) Clare Howard (NERC)
Task 3.4.3 Engagement and dissemination of the INMS approach to regional N cycle assessment	INI (PCU) INI (PCU)	Mark Sutton (NERC) Clare Howard (NERC)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Component 4: Awareness raising and knowledge sharing		
Activity 4.1 **Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement)**	INI INI (PCU)	Albert Bleeker (PBL) Clare Howard (NERC)
Task 4.1.1 Establishment, population & operation of INMS web portal	INI INI (PCU)	Albert Bleeker (PBL) Clare Howard (NERC)
Task 4.1.2 Establishment & maintenance of INMS database including links to other data sources	INI INI (PCU)	Bill Bealey (NERC) Clare Howard (NERC)
Task 4.1.3 Develop communications function for INMS partners	INI (PCU) INI	Clare Howard (NERC) Albert Bleeker (PBL)
Task 4.1.4 Develop press and public engagement function for INMS	INI (PCU) INI (PCU)	Clare Howard (NERC) Mark Sutton (NERC)
Activity 4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting	INI INI (PCU)	Albert Bleeker (PBL) Clare Howard (NERC)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Task 4.2.1 Training in nitrogen measurement, modelling and mitigation techniques	INI INI (PCU)	Albert Bleeker (PBL) Clare Howard (NERC)
Task 4.2.2 International engagement of the project to foster better understanding of N challenges	OECD INI (PCU)	Gerard Bonnis (OECD) Mark Sutton (NERC)
Task 4.2.3 Share experiences on N foot-printing as a means of developing public awareness	INI INI North America	Albert Bleeker (PBL) Jim Galloway (UVA)
Activity 4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & development of long-term strategy	INI (PCU) GPA	Mark Sutton (NERC) Chris Cox (GPA)
Task 4.3.1 Development of synthesis to demonstrate INMS in support of GPA objectives	GPA INI (PCU)	Chris Cox (GPA) Mark Sutton (NERC)
Task 4.4.1 Coordination of INMS inputs to other policy processes	INI (PCU) INI (PCU)	Clare Howard (NERC) Mark Sutton (NERC)
Task 4.4.2 Development of a long-term strategy for INMS, inc. policy homes & financing models	INI (PCU) GPA	Mark Sutton (NERC) Chris Cox (GPA)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Activity 4.5 Harmonization, publication & dissemination of guidance documents across components	INI (PCU) INI	Clare Howard (NERC) Albert Bleeker (PBL)
Task 4.5.1 Harmonization & publication of guidance on N budgets, efficiency & benchmarking	INI (PCU) INI	Clare Howard (NERC) Albert Bleeker (PBL)
Task 4.5.2 Harmonization and publication of guidance on threats, fluxes & distribution methods	INI (PCU) INI	Clare Howard (NERC) Albert Bleeker (PBL)
Task 4.5.3 Harmonization & publication on N measures and good practices inc. barriers and successes	INI (PCU) INI	Clare Howard (NERC) Albert Bleeker (PBL)
Activity 4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP	INI (PCU) INI	Clare Howard (NERC) Albert Bleeker (PBL)
Task 4.6.1 Provide 1% of project resources to support IW:LEARN	INI (PCU)	Clare Howard (NERC)

Table A8.2		
ACTIVITY/TASK	**RESPONSIBILITY ASSIGNMENT**	
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**
Task 4.7.1 Connect INMS website with IW-LEARN & other GEF systems	INI (PCU) INI	Clare Howard (NERC) Albert Bleeker (PBL)
Task 4.8.1 Cooperate with IW-LEARN and STAP inc. development of a N Community of Practice (CoP).	INI (PCU) INI	Clare Howard (NERC) Albert Bleeker (PBL)
Task 4.9.1 Participate in Int. Waters Conferences and prepare INMS Experience Notes	INI (PCU) INI	Clare Howard (NERC) Albert Bleeker (PBL)

Table A.3			
M&E COMPONENT/ ACTIVITY	**RESPONSIBILITY ASSIGNMENT**		**MEANS OF ASSESSMENT/ MONITORING DATA SOURCE**
	INSTITUTION/ AGENCY	**PROJECT/ AGENCY OFFICER**	
Evaluation			
INI / PCU Supervision missions	PCU	Project Coordinator	On-site data collection Mission reports
Meetings of the Project Management Board (PMB)	PCU (Secretariat)	Project Coordinator UNEP Task Manager	Minutes of the meetings PMB
Meetings of the Stakeholder and Policy Advisory Group (SPAG)	PCU (Secretariat)	Project Coordinator (Secretariat) UNEP Task Manager	Minutes of the meetings SPAG
Meetings of the Project Partners Assembly (PPA)	PCU (Secretariat)	Project Coordinator (Secretariat) UNEP Task Manager	Minutes of the meetings PPA
Mid-Term Evaluation	UNEP in consultation with the PCU, and participating institutions and stakeholders	Project Coordinator	On-site data collection Project Coordinator review
Final Evaluation	UNEP in consultation with the PCU, and participating institutions and stakeholders	Independent consultant	On-site data collection Consultant report
Annual Project Implementation Review (PIR)	NERC with the assistance of participating Institutions	Project Coordinator in consultation with UNEP Task Manager	On-site data collection PIR reports

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 09

Terms of Reference for Terminal Evaluation

Table of Contents

1 Project Background and Overview

The nitrogen challenge

Human perturbation of the global nitrogen cycle in the 21st century is leading both to massive benefits for food and energy production and to multiple environmental threats. Although nitrogen is abundant in the atmosphere in its unreactive form (N_2) it is unavailable for most organisms. At the same time, the supply of reactive nitrogen (N_r) compounds is limited under natural conditions. Anthropogenic inputs of N_r include fertilizer production, crop biological nitrogen fixation, and nitrogen oxides (NO_x) from combustion sources. As a result of these inputs, humans have more than doubled global terrestrial rates of N_r formation.

The benefits have been huge. It has been estimated that fertilizers N_r from the Haber-Bosch process sustain nearly 50% of the human population according to current diets, without which there would be massive problems of hunger and malnutrition in many parts of the world. The increased crop production over the last century has also allowed substantial increases in livestock population, enriching human diets and producing many other products. In addition, agricultural N_r inputs provide a foundation for bioenergy production, offering the potential to replace fossil fuels with renewable products.

Against these benefits, the environmental consequences of anthropogenic fixation of N_2 to N_r have been equally large. The overall global doubling of N_r flows has led to a web of pollution problems, often described in terms of the 'nitrogen cascade', where N_r converts between many chemical forms in different environmental compartments, resulting in multiple environmental impacts. This process is driven by the dissipation of energy contained in the N_r until it is eventually 'denitrified' back to atmospheric N_2. The consequences include water pollution of both freshwater and coastal marine systems, air pollution, greenhouse gas emissions, stratospheric ozone depletion, with threats for ecosystems, biodiversity and soil quality. The result is an array of adverse impacts on environment, health and livelihoods.

The goal of intentional N_r fixation is plant and animal growth, forming many N compounds such as amino acids, proteins, enzymes and DNA. Key losses of N_r include ammonia (NH_3), nitric oxide (NO), nitrates (NO_3) and nitrous oxide (N_2O). Even denitrification losses to form N_2 are polluting, since they represent a waste of the substantial resources (2% of world energy) used to make N_r.

To date, there has been little joined up effort to address these threats and benefits. This is the challenge addressed by 'Towards INMS'. Until now, many GEF interventions have included selected aspects of N as part water quality issues. Similarly, several international projects have addressed the issues of atmospheric NH_3 or N_2O emissions and their possible solutions. Each of these efforts, however, has been conducted in a fragmented way. At the same time, there are substantial barriers to achieve the desired goals of better water quality, cleaner air, reduced greenhouse gas emissions etc.

The INMS hypothesis

'Towards INMS' is developed with the recognition that the present lack of a coherent approach across the nitrogen cycle contributes substantially to these barriers. *'Towards INMS' therefore addresses the hypothesis that joined up management of the nitrogen cycle will offer many co-benefits that strengthen the case for action for cleaner water, cleaner air, reduced greenhouse gas emissions, better soil and biodiversity protection, while at the same time helping to meet food and energy goals.*

This approach also feeds back into each of the usual topic domains. For example, where actions needed to reduce the effects of N on transboundary waters can be shown simultaneously to deliver quantified co-benefits for air, climate, food, energy, then this will more strongly motivate the necessary changes for water protection. The same applies for each of the other threat and benefit policy domains (food, air, climate, soil etc). By acting together through the nitrogen cycle, there is the potential to transform efforts for a cleaner and healthier environment.

Goal of Towards INMS

'Towards INMS' is prepared as a GEF 'Targeted Research Project' at the global scale. This is not research in the traditional sense of focusing on fundamental science. It is rather research in how these issues can be brought together to provide tools, approaches, information and demonstration that can support the mobilization of change at a global scale. 'Towards INMS' is therefore pitched clearly at the interface of science-policy-practice development.

With this framing, Towards INMS, has been developed with a broad partnership to address the following project objective: *To improve the understanding of the global/region N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems.*[1]

The indicators given in the project document for this stated objective were:

- National / regional / global bodies developing new policies based on the INMS approach to manage N_r [P]
- Number of stakeholder groups (including private sector, such as fertiliser and food related industries) supporting / endorsing INMS methodology and using tools to inform internal policies [P]
- Wider recognition from the public and civil society groups of the need for an INMS approach to managing N_r [P]

At the same time, it is recognized that 'Towards INMS' has a central role to play in catalyzing the global policy community to develop more effective global and regional strategies to manage the nitrogen cycle. This is the reason that the project is titled "*Towards*" the International Nitrogen Management System. Such an international system of science and practice support for policies in the global nitrogen cycle does not currently exist. 'Towards INMS' is therefore a key step in this process, where the system of science, evidence and options provision (representing the scope of INMS) can work hand in hand with improved coordination among policy makers. 'Towards INMS' thereby parallels ongoing developments in the international policy arena for nitrogen.

'Towards INMS' is highly relevant to support several international policy processes. These include the Global Programme of Action for the protection of the marine environment from land-based activities (GPA), the UN Convention on Biological Diversity (CBD), the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), the UN Framework Convention on Climate Change (UNFCCC), the Vienna Convention (and Montreal Protocol), as well as the regional waters and seas conventions, and the programs of UNEP, FAO, WMO, OECD, UNECE and others. This approach is highly relevant as a focused contribution to meeting many of the Sustainable Development Goals, especially as the

[1] Discussion with stakeholders during the first Plenary Meeting (Lisbon, 2015) has also allowed this to be extended in framing a *Long-term Goal*: "To improve the understanding of the global and regional N cycle and investigate practices and policies to maximize sustainable production of food, goods and energy while reducing negative impacts of reactive nitrogen on the environment and human health."

nitrogen cycle cuts across so many of the different goals (especially SDGs 1, 2, 3, 5, 7, 8, 9, 11, 12, 13, 14, 15).

Main Anticipated Outcomes

The main outcomes of Towards INMS are as follows:

1. Stakeholders, including policy makers, scientists, industry, farmers, business and civil society, have an agreed basis for informed decision making on N cycle management.
2. Stakeholders using agreed assessment and quantification methods to evaluate N cycle status acting as a common basis for regional / global scenarios to guide management actions.
3. Regional and Global information on N cycle fluxes and impacts, enabling strategies to be implemented to minimise negative effects of excess or insufficient reactive N, while maximising the quantified co-benefits for other sectors including the Green and Circular Economies.
4. GPA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised.
5. Local, national and regional expertise to address N_r issues increased and contributes to improved GPA and other decision-making at the regional / global levels.

Operational outcomes include improved access to and sharing of information in cooperation with IW:LEARN; Improved knowledge management with compiled knowledge and experiences about the project shared with other GEF projects and GEF Secretariat, accessible on IW:LEARN; Improved project execution from IW Conference participation and the use of the GEF5 IW indicator tracking system.

Relevance to GEF Programmes

1. The GEF (together with other donors) has had a long history of supporting projects to address the problems of excess nutrients and their impacts on coastal zones (summarized in the STAP 2011 report)[2] through the implementation of transformative management changes and through practical demonstration projects, for example reducing nutrient loss from farms through Agriculture Pollution Control (APC) activities in the Danube River Basin. In addition, the GEF has invested in targeted research projects over the past ten years ago to understand nutrient and carbon cycling in coastal zones[3] that will be further built upon within 'Towards INMS'. The problems of insufficient N_r have not previously been a focus under GEF IW, but are highly relevant to avoid emerging pollution problems as human populations rapidly expand. In this context, the project will build on the baseline established by key partners, including amongst work of the CGIAR (formerly the Consultative Group on International Agricultural Research), including the International Institute for Tropical Agriculture (IITA) and the International Livestock Research Institute (ILRI), as well as other partners such as the International Plant Nutrition Institute (IPNI). In order to ensure balance, groups with interest in both conventional and organic farming methods included.

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[2] STAP (2011) Hypoxia and Nutrient Reduction in the Coastal Zone: Advice for Prevention, Remediation and Research
[3] UNEP/GEF The Role of the Coastal Ocean in the Disturbed and Undisturbed Nutrient and Carbon Cycles, executed by LOICZ - a sister programme to the INI under the International Geosphere-Biosphere Programme (IGBP)

2. The GEF has recently completed the UNEP project 'Global Foundations for reducing nutrient enrichment and oxygen depletion from land-based pollution in support of the global nutrient cycle' (Global Nutrient Foundations, or **GNC project**) which contributes to the work of the GPNM and is one of the building blocks contributing to the baseline for the proposed project. The core objective of the GNC project has been "to provide the foundations (including partnerships, information, tools and policy mechanisms) for governments and other stakeholders to initiate comprehensive, effective and sustained programmes addressing nutrient over-enrichment and oxygen depletion from land based pollution of coastal waters in Large Marine Ecosystems". Although the focus is therefore not exactly the same as 'Towards INMS' (with GNC focusing on coastal waters only and nutrients rather than nitrogen), it nevertheless provides outcomes that are relevant for 'Towards INMS'.

3. The present achievement of the GEF/UNEP GNC project can be summarized as:

- The development and application of quantitative modelling approaches: to estimate and map present day contributions of different watershed based nutrient sources to coastal nutrient loading and their effects; to indicate when nutrient over-enrichment problem areas are likely to occur; and to estimate the magnitude of expected effects of further nutrient loading on coastal systems under a range of scenarios.
- A systematic analysis of available scientific, technological and policy options for managing nutrient over-enrichment impacts in the coastal zone from key nutrient source sectors such as agriculture, wastewater and aquaculture, and their bringing together an overall Policy Tool Box.
- A basis that can contribute to future modelling to assess the likely impact and overall cost effectiveness of the various policy options etc. brought together in the Tool Box, so that resource managers have a means to determine which investments and decisions they can better make in addressing root causes of coastal over-enrichment through nutrient reduction strategies.
- The application of this approach in the Manila Bay (Philippines) watershed and at Lake Chilika (India) with a view to helping deliver the key tangible outcome of the project – the development of stakeholder owned, cost-effective and policy relevant nutrient reduction strategies (containing relevant stress reduction and environmental quality indicators), which can be mainstreamed into broader planning.
- A consolidated global partnership on nutrient management to provide a stimulus for the effective development, replication, up-scaling and sharing of these key outcomes.

4. 'Towards INMS' is conceived with many links to on-going programmes and initiatives with an interest in reactive nitrogen and will actively involve these in both the development of the full-sized project and throughout the project's implementation. It will exploit other GEF interests and achievements in nutrients and coastal eutrophication, including through GEF IW projects including the Transboundary Water Assessment Programme (TWAP) with an expectation of exchange of data and methods.

5. The project is closely linked and aligned to the goals of the GPA and will work with the UNEP Regional Seas Programme to co-ordinate activities and recommendations to protect the marine environment. The Executing Agency (INI) will provide significant links to their programmes, assisting with both excess and insufficient reactive nitrogen, and provide close co-operation with the broader initiatives of the IGBP and SCOPE, including with the LOICZ (Land-Ocean Interactions in the Coastal Zones) programme which GEF IW has previously supported, as well as broader linkages with the international 'Future Earth' research community.

6. 'Towards INMS' will be closely linked with the GEF IW:LEARN to share the experiences and knowledge gained and will actively participate at the International Waters Conferences to further encourage enhanced linkages between the science and policy actors to strengthen the approaches to nutrient management and food security. Similarly, the project will provide a contribution focused on

nitrogen that complements the developing Water-Food-Energy-Ecosystem Nexus Assessment of the UNECE Transboundary Waters Convention, as well as activities under the Task Force on Reactive Nitrogen (TFRN) of the UNECE Convention on Long-range Transboundary Air Pollution, including its development of Guidance Documents on nitrogen mitigation, nitrogen budgets and integrated approaches.

Institutional Framework and Implementation Arrangements

Project Level Decision Making and Planning

The overall project governance and internal communication flows within the 'Towards INMS' project are summarized in Figure 1. General oversight of project activities will be undertaken by the Project Management Board (PMB), which will allow project-level communication between the Component Leaders, the Project Co-ordination Unit (PCU), the Executing Agency (EA) (i.e. NERC-CEH on behalf of INI) and the Implementing Agency (IA) (i.e. UNEP). The PCU will undertake the day-to-day functions of the project, including maintaining communication between all parties in the project. Each of these groups is outlined below and further details can be found in Appendix 10.

The work of the project will be reviewed and informed by the Project PartnersAssembly (PPA), which consists of representatives of all main partners (i.e. funding partners). It represents the overarching decision-making body. In addition, the project includes a Stakeholder and Policy Advisory Group (SPAG) to provide advice to the project and support wider dissemination. Members of the SPAG may also be Main Partners of the project, in which case they will also be members of the PPA. Members of the SPAG otherwise have observer status at the PPA. External communication from the project is further supported by Component 4, which includes focus on public engagement and awareness raising. In addition to the partnership itself, the PCU and Partners may also utilize Consultants to conduct specific aspects of the work. Such consultants have observer status at the PPA, being represented in decisions of the PPA by their relevant hosting Main Partner.

Project Management Board

The PMB will be established to oversee the activities of the project and to approve material (reports, outputs, etc.) for submission to the PPA, IA and to the GEF. The PMB will provide overall guidance to the project and will consist of EA, PCU (on behalf of the IA) and the Component Leaders. The PMB will meet as required for the execution of the project, making full use of electronic conferencing facilities. The PMB will receive direction (consistent with the Pro-Doc/CEO) from the PPA, supported by advice from the SPAG acting as the executive of the Towards INMS Project.

Note that the PMB will not be expected to deal with day-to-day administration of the project, which will be handled by the Project Co-ordinator, Project Director and PCU, under guidance from the IA. This will ensure conformity with UNEP's and GEF's requirements.

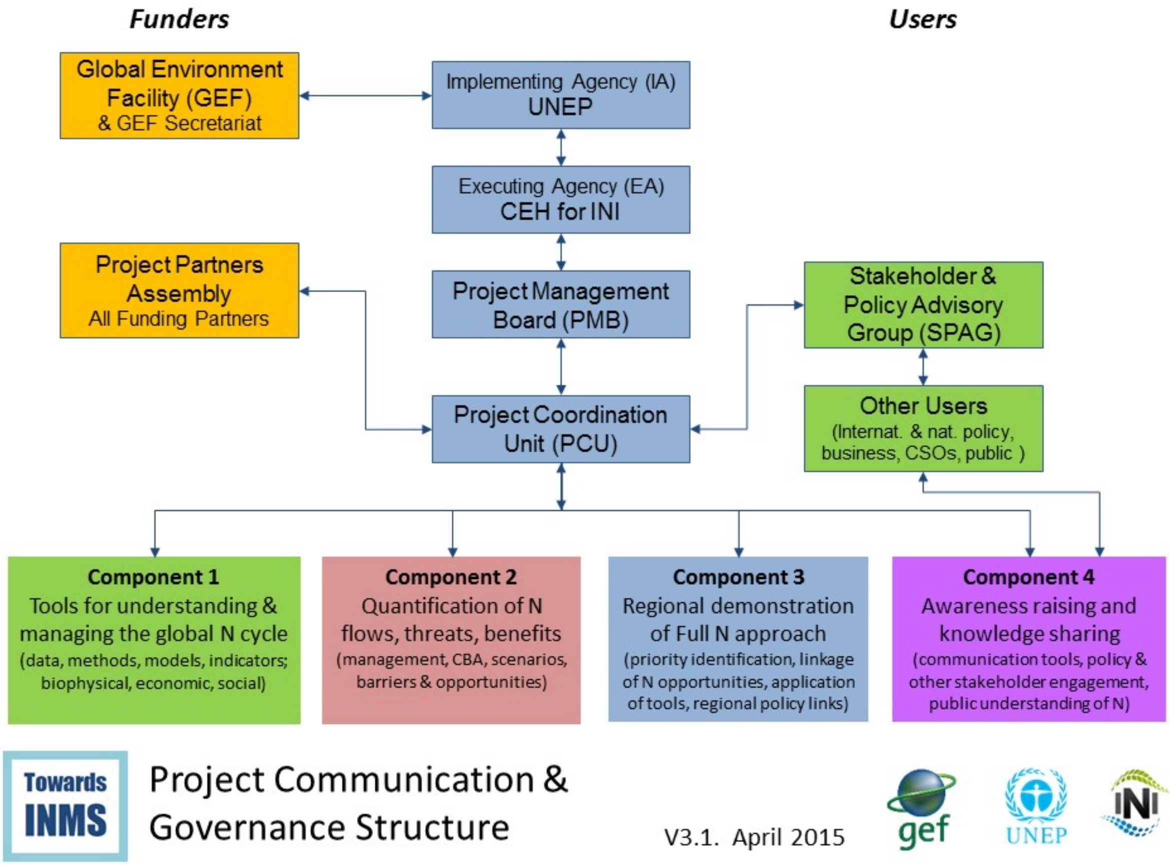

Figure 1: *Summary of the Towards INMS project communication and governance structure. Catalytic funding is provided by the Global Environment Facility, while all funding partners are represented in the Project Partners Assembly. UNEP is the Implementing Agency (IA), while the International Nitrogen Initiative (INI) is the Executing Agency (EA), as hosted by CEH. The Project Coordination Unit (PCU) is the team that actually manages the project coordination (based at the EA), who work closely with the Project Management Board (Component Leaders, IA and EA). The project is supported by the Stakeholder and Policy Advisory Group (SPAG), which consists of key users, which may also be project partners. Membership of the SPAG will be proposed during project Inception Phase by the EA and IA, for agreement by the Project Partners Assembly.*

Project Co-ordination Unit (PCU)

The Project Co-ordination Unit (PCU) will be responsible for day-to-day project management and execution and will work closely with the project partners to ensure the objectives of this project are achieved. They will be responsible for providing the PPA, PMB, IA and the GEF with all management information and the required outputs from this project. The PCU will be responsible for the organization of the Inception Meeting and subsequent meetings of the Project Partners Assembly, and provide secretariat facilities for PMB, PPA and SPAG.

The PCU will consist of a Project Director (25% Full Time Equivalent, FTE), Project Co-ordinator (100% FTE), Technical support specialist (50% FTE), Project Management and Communications support will also be provided (up to 100% FTE, depending on staffing needs and availability) and financial support staff (25%). Terms of reference for these roles can be found in Appendix 11.

Project Partners

Two partner types are defined for the 'Towards INMS' project, as follows:

Main Partners: Organizations who have provided co-financing through cash and in-kind contributions to the project. Main Partners may also take on 'Co-ordinating' and/or 'Lead' roles. Co-ordinating Partners are those within the Project Management Board (such as Component Leaders) and Lead Partners are responsible for the delivery of either an Activity or Task. As a contributor to project co-financing, each Main Partner is a full member of the PPA.

Associate Partners: Organisations who have not provided co-financing, but who have otherwise committed to contribute to or otherwise support the project.

The Partners are the organizations contributing to 'Towards INMS'. Each organization will support the work through one or more of its staff, one of whom will be appointed by the Partner to be their Lead Representative for 'Towards INMS' at the PPA (Lead Representatives of Main Partners would therefore be voting members of the PPA).

Following the inception meeting the IA and EA may agree to propose additional Main Partners or Associate Partners to the project, which will require approval of the PPA before acceptance of a new partner is confirmed.

Project Partners Assembly

'Towards INMS' has around 80 Main Partners contributing funding resources to the project. Their involvement is critical and essential to the overall delivery of the project. Each Main Partner will be directly represented as part of the Project Partners Assembly (PPA), which will meet annually. As the aggregate of all funding partners, the PPA is the overarching decision making body of 'Towards INMS'. Associate Partners (i.e. non-funding partners) contribute to the PPA as non-voting members. The PPA will support the execution of the project through the PMB and the PCU, who will report to the PPA annually. Members of the SPAG who are not Partners of INMS and other groups or individuals with an interest in INMS join the PPA as observers. As far as possible the PPA will take decisions by consensus.

Stakeholder and Policy Advisory Group (SPAG)

A Stakeholder and Policy Advisory Group (SPAG) will be established during the INMS Inception Phase and will meet on an ad hoc basis. A proposal for membership will be made by the PMB for adoption or amendment by the PPA. The group will advise the PMB on scientific, policy and other stakeholder issues as needed to support development of options for an International Nitrogen Management System. The SPAG will be composed of differing expertise as the needs of the project evolve and may include Partners as well as other bodies and individual experts.

Component Level & Regional Demonstrations, Decision Making and Planning

Decision Making & Planning in Components 1, 2 & 4

As described above, project level communication and governance of the work of the Components will be directed by the PMB. Within each Component are a number of Activities (each delivering on one 'Output') and within these, several Tasks (each delivering on a 'Task Output').

To ensure effective delivery of the 'Outputs' and 'Outcomes' of the project, each Component, Activity and Task is guided by a 'Leader' (in most cases two, allowing for flexibility and greater global representation). 'Terms of Reference' for each of these roles is included in Appendix 11. Component Leaders will be responsible for reporting back to the PCU and PMB on their progress and any issues which need to be addressed, including budget or Work Plan adjustments. Each of the Component Leaders will work with the Activity Leaders and Task Leaders.

Proposals individuals to act as Component Leaders, Activity Leaders and Task Leaders have been made by the EA as shown in Appendices 8 and 15-18. The proposals have been made considering i) relevant expertise, ii) institutional context, including Execution of the project through INI, iii) global and regional representativeness, iv) gender representativeness, v) contribution to preparing the 'Towards INMS' PPG phase and documentation. The EA will confirm nomination of Component Leaders, Activity Leaders and Task Leaders for approval or amendment by the PPA during the Project Inception Phase.

Decision Making & Planning in Component 3 & the Regional Demonstrations

To effectively execute the work planned in Component 3, it is necessary that communication flows between each of the regional demonstrations in Activity 3.1 and the remaining activities (A3.2-3.4). Therefore, it is planned to have a 'Component 3 Management Group' (C3MG) which consists of the Component 3 Leaders, Activity leaders and representation from each of the regional demonstrations. Each of the Demonstrations will also form a 'Demonstration Management Group' (DMG), consisting for example of the Regional Co-ordinator(s), Project Officer(s), Task Leaders and additional experts as required.

Budget

An outline budget for the project is provided below. Further details can be found in Appendices 1 & 2 to the Project Document.

	IN CASH CO-FINANCING	IN KIND CO-FINANCING	TOTAL CO-FINANCING	GEF FUNDING	TOTAL FUNDING
Component 1 : Tools and Methods for the N cycle	$6,010,172	$18,248,998	$24,259,170	$1,400,000	**$25,659,170**
Component 2: Quantification of N flows, threats and benefits	$1,954,440	$14,448,035	$16,402,475	$1,680,000	**$18,082,475**
Component 3: Regional Demonstrations	$1,857,007	$8,397,624	$10,254,630	$1,650,000	**$11,904,630**
Component 4: Awareness raising and knowledge sharing	$1,153,382	$4,506,249	$5,659,631	$980,000	**$6,639,631**
PCU				$290,000	$290,000
TOTAL	**$10,975,000**	**$45,600,907**	**$56,575,907**	**$6,000,000**	**$62,575,907**

2 Objective and Scope of the Evaluation

The objective of the terminal evaluation is to examine the extent and magnitude of any project impacts to date and determine the likelihood of future impacts. The evaluation will also assess project performance and the implementation of planned project activities and planned outputs against actual results. The evaluation will focus on the following main questions:

1. Did the project help to raise awareness and understanding of excess and insufficient reactive nitrogen issues and challenges among key target audiences (GEF Secretariat and GEF Council; UNEP; Regional organizations and National governments)
2. Did the project help key institutions improve nitrogen management?
3. Did the outputs of the project articulate options and recommendations for priority areas for future intervention? Were these options and recommendations used? If so by whom?
4. To what extent did the project outputs produced have the weight of scientific authority and credibility necessary to influence policy makers and other key audiences?

2.1 Methods

This terminal evaluation will be conducted as an in-depth evaluation using a participatory approach whereby the UNEP Task Manager, key representatives of the executing agencies and other relevant staff are kept informed and consulted throughout the evaluation. The consultant will liaise with the UNEP/ Evaluation and Oversight Unit (EOU) and the UNEP Task Manager on any logistic and/or methodological issues to properly conduct the review in as independent a way as possible, given the circumstances and resources offered. The draft report will be circulated to UNEP Task Manager, key representatives of the executing agencies and the UNEP/EOU. Any comments or responses to the draft report will be sent to UNEP/EOU for collation and the consultant will be advised of any necessary or suggested revisions.

The findings of the evaluation will be based on the following:

1. A desk review of project documents including, but not limited to:
    (a) The project documents, outputs, monitoring reports (such as progress and financial reports to UNEP and GEF annual Project Implementation Review reports) and relevant correspondence.
    (b) Reports from the Project Board and Project Partners Assembly meetings.
    (c) Other project-related material produced by the project staff or partners.
    (d) Relevant material published on the project web-site: www.inms.international
2. Interviews with project management and technical support including staff of the Project Co-ordinating Unit in INI/CEH; and other partners as deemed necessary.
3. Interviews and Telephone interviews with intended users for the project outputs and other stakeholders involved with this project, including in the participating countries and international bodies. The Consultant shall determine whether to seek additional information and opinions from representatives of donor agencies and other organizations. As appropriate, these interviews could be combined with an email questionnaire.
4. Interviews with the UNEP Task Manager and Fund Management Officer, and other relevant staff in UNEP dealing with International Waters related activities as necessary. The Consultant shall also gain broader perspectives from discussions with relevant GEF Secretariat staff.
5. Field visits to project staff of the executing agency and potentially the lead partners in the demonstration activities. In this project there are five demonstration activities, however the costs involved in travel to visit all of them would be prohibitive. It is proposed therefore that a series of teleconferences be held between the evaluators and the lead partners of the demonstration activities as appropriate with the option of possible site visits to be determined on a case by case basis.

2.2 Key Evaluation principles.

In attempting to evaluate any outcomes and impacts that the project may have achieved, evaluators should remember that the project's performance should be assessed by considering the difference between the answers to two simple questions ***"what happened?"*** and ***"what would have happened***

anyway?". These questions imply that there should be consideration of the baseline conditions and trends in relation to the intended project outcomes and impacts. In addition, it implies that there should be plausible evidence to **attribute** such outcomes and impacts **to the actions of the project**.

Sometimes, adequate information on baseline conditions and trends is lacking. In such cases this should be clearly highlighted by the evaluator, along with any simplifying assumptions that were taken to enable the evaluator to make informed judgements about project performance.

2.3 The Evaluation

2.3.1 Project Ratings

The success of project implementation will be rated on a scale from 'highly unsatisfactory' to 'highly satisfactory'. In particular the evaluation shall **assess and rate** the project with respect to the eleven categories (a-k) defined below:[4]

A. Attainment of objectives and planned results:

The evaluation should assess the extent to which the project's major relevant objectives were effectively and efficiently achieved or are expected to be achieved and their relevance.

- *Effectiveness:* Evaluate how, and to what extent, the stated project objectives have been met, taking into account the "achievement indicators". The analysis of outcomes achieved should include, *inter alia*, an assessment of the extent to which the project has directly or indirectly assisted policy and decision-makers to apply information supplied by nitrogen related indicators in their national planning and decision-making. In particular:
  - Evaluate the immediate impact of the project on the International Waters Focal area monitoring and in national planning and decision-making and international understanding and use of transboundary waters indicators
  - As far as possible, also assess the potential longer-term impacts considering that the evaluation is taking place upon completion of the project and that longer term impact is expected to be seen in a few years' time. Frame recommendations to enhance future project impact in this context. Which will be the major 'channels' for longer term impact from the project at the national and international scales?
- *Relevance*: In retrospect, were the project's outcomes consistent with the focal areas/operational program strategies? Ascertain the nature and significance of the contribution of the project outcomes to the United Nations water assessment processes and the wider portfolio of the GEF.
- *Efficiency*: Was the project cost effective? Was the project the least cost option? Was the project implementation delayed and if it was, then did that affect cost-effectiveness? Assess the contribution of cash and in-kind co-financing to project implementation and to what extent the project leveraged additional resources. Did the project build on earlier initiatives, did it make effective use of available scientific and / or technical information. Wherever possible, the evaluator should also compare the cost-time vs. outcomes relationship of the project with that of other similar projects.

[4] The views and comments expressed by the evaluator need not be restricted to these items.

B. Sustainability:

Sustainability is understood as the probability of continued long-term project-derived outcomes and impacts after the GEF project funding ends. The evaluation will identify and assess the key conditions or factors that are likely to contribute or undermine the persistence of benefits after the project ends. Some of these factors might be outcomes of the project, e.g. stronger institutional capacities or better informed decision-making. Other factors will include contextual circumstances or developments that are not outcomes of the project but that are relevant to the sustainability of outcomes. The evaluation should ascertain to what extent follow-up work has been initiated and how project outcomes will be sustained and enhanced over time.

Five aspects of sustainability should be addressed: financial, socio-political, institutional frameworks and governance, environmental (if applicable). The following questions provide guidance on the assessment of these aspects:

- *Financial resources.* Are there any financial risks that may jeopardize sustenance of project outcomes? What is the likelihood that financial and economic resources will not be available once the GEF assistance ends (resources can be from multiple sources, such as the public and private sectors, income generating activities, and trends that may indicate that it is likely that in future there will be adequate financial resources for sustaining project's outcomes)? To what extent are the outcomes of the project dependent on continued financial support?
- *Socio-political:* Are there any social or political risks that may jeopardize sustainability of project outcomes? What is the risk that the level of stakeholder ownership will be insufficient to allow for the project outcomes to be sustained? Do the various key stakeholders see that it is in their interest that the project benefits continue to flow? Is there sufficient public / stakeholder awareness in support of the long term objectives of the project?
- *Institutional framework and governance.* To what extent is the sustainability of the outcomes of the project dependent on issues relating to institutional frameworks and governance? What is the likelihood that institutional and technical achievements, legal frameworks, policies and governance structures and processes will allow for, the project outcomes/benefits to be sustained? While responding to these questions consider if the required systems for accountability and transparency and the required technical know-how are in place.
- *Environmental.* Are there any environmental risks that can undermine the future flow of project environmental benefits? The Terminal Evaluation should assess whether certain activities in the project area will pose a threat to the sustainability of the project outcomes. For example; construction of dam in a protected area could inundate a sizable area and thereby neutralize the biodiversity-related gains made by the project; or, a newly established pulp mill might jeopardise the viability of nearby protected forest areas by increasing logging pressures; or a vector control intervention may be made less effective by changes in climate and consequent alterations to the incidence and distribution of malarial mosquitoes.

C. Achievement of outputs and activities:

- Delivered outputs: Assessment of the project's success in producing each of the programmed outputs, both in quantity and quality as well as usefulness and timeliness.
- Assess the soundness and effectiveness of the methodologies used for developing the technical documents and related management options in the participating countries.
- Assess to what extent the project outputs produced have the weight of scientific authority / credibility, necessary to influence policy and decision-makers, particularly at the national level.

D. Catalytic Role

The project contains no plans to replicate or catalyse action in the classical meaning of these terms but one stated output is a formalised network of partners to advise, co-plan and co-implement future national level interventions. In this sense the project should be evaluated for its catalytic contribution.

E. M&E during project implementation

The evaluation shall include an assessment of the quality, application and effectiveness of project monitoring and evaluation plans and tools, including an assessment of risk management based on the assumptions and risks identified in the project document. The Terminal Evaluation will assess whether the project met the minimum requirements for 'project design of M&E' and 'the application of the Project M&E plan' (see minimum requirements 1&2 in *Annex 4* to this Appendix). GEF projects must budget adequately for execution of the M&E plan, and provide adequate resources during implementation of the M&E plan. Project managers are also expected to use the information generated by the M&E system during project implementation to adapt and improve the project.

- *M&E design.* Projects should have sound M&E plans to monitor results and track progress towards achieving project objectives. An M&E plan should include a baseline (including data, methodology, etc.), SMART indicators (see Annex 4) and data analysis systems, and evaluation studies at specific times to assess results. The time frame for various M&E activities and standards for outputs should have been specified.
- *M&E plan implementation.* A Terminal Evaluation should verify that: an M&E system was in place and facilitated timely tracking of results and progress towards projects objectives throughout the project implementation period (perhaps through use of a log frame or similar); annual project reports and Progress Implementation Review (PIR) reports were complete, accurate and with well justified ratings; that the information provided by the M&E system was used during the project to improve project performance and to adapt to changing needs; and that projects had an M&E system in place with proper training for parties responsible for M&E activities.
- *Budgeting and Funding for M&E activities.* The terminal evaluation should determine whether support for M&E was budgeted adequately and was funded in a timely fashion during implementation.

F. Preparation and Readiness

Were the project's objectives and components clear, practicable and feasible within its timeframe? Were the capacities of executing institution and counterparts properly considered when the project was designed? Were lessons from other relevant projects properly incorporated in the project design? Were the partnership arrangements properly identified and the roles and responsibilities negotiated prior to project implementation? Were counterpart resources (funding, staff, and facilities), enabling legislation, and adequate project management arrangements in place?

G. Country ownership / driveness:

This is the relevance of the project to national development and environmental agendas, recipient country commitment, and regional and international agreements. The evaluation will:

- Assess the level of country ownership. Specifically, the evaluator should assess whether the project was effective in providing and communicating nitrogen threat and benefit indicator related information that catalyzed action in participating countries to improve decisions relating to the management of insufficient and excess reactive nitrogen.

- Assess the level of country commitment to the use of the INMS approach to support decision-making during and after the project, including in regional and international fora.

H. Stakeholder participation / public awareness:

This consists of three related and often overlapping processes: information dissemination, consultation, and "stakeholder" participation. Stakeholders are the individuals, groups, institutions, or other bodies that have an interest or stake in the outcome of the GEF- financed project. The term also applies to those potentially adversely affected by a project. The evaluation will specifically:

- Assess the mechanisms put in place by the project for identification and engagement of stakeholders in each participating country and establish, in consultation with the stakeholders, whether this mechanism was successful, and identify its strengths and weaknesses.
- Assess the degree and effectiveness of collaboration/interactions between the various project partners and institutions during the course of implementation of the project.
- Assess the degree and effectiveness of any various public awareness activities that were undertaken during the course of implementation of the project.

I. Financial Planning

Evaluation of financial planning requires assessment of the quality and effectiveness of financial planning and control of financial resources throughout the project's lifetime. Evaluation includes actual project costs by activities compared to budget (variances), financial management (including disbursement issues), and co- financing. The evaluation should:

- Assess the strength and utility of financial controls, including reporting, and planning to allow the project management to make informed decisions regarding the budget and allow for a proper and timely flow of funds for the payment of satisfactory project deliverables.
- Present the major findings from the financial audit if one has been conducted.
- Identify and verify the sources of co- financing as well as leveraged and associated financing (in co-operation with the IA and EA).
- Assess whether the project has applied appropriate standards of due diligence in the management of funds and financial audits.
- The evaluation should also include a breakdown of final actual costs and co-financing for the project prepared in consultation with the relevant UNEP Fund Management Officer of the project (table attached in *Annex 2* to this Appendix Co-financing and leveraged resources).

J. Implementation approach:

This includes an analysis of the project's management framework, adaptation to changing conditions (adaptive management), partnerships in implementation arrangements, changes in project design, and overall project management. The evaluation will:

- Ascertain to what extent the project implementation mechanisms outlined in the project document have been closely followed. In particular, assess the role of the various committees established and whether the project document was clear and realistic to enable effective and efficient implementation, whether the project was executed according to the plan and how well the management was able to adapt to changes during the life of the project to enable the implementation of the project.
- Evaluate the effectiveness and efficiency and adaptability of project management and the supervision of project activities / project execution arrangements at all levels (1) policy decisions: Project Management Board/Project Partners Assembly; (2) day to day project management at the Executing Agency.

K. UNEP Supervision and Backstopping

- Assess the effectiveness of supervision and administrative and financial support provided by UNEP
- Identify administrative, operational and/or technical problems and constraints that influenced the effective implementation of the project.

The ***ratings will be presented in the form of a table***. Each of the eleven categories should be rated separately with **brief justifications** based on the findings of the main analysis. An overall rating for the project should also be given. The following rating system is to be applied:

HS = Highly Satisfactory

S = Satisfactory

MS = Moderately Satisfactory

MU = Moderately Unsatisfactory

U = Unsatisfactory

HU = Highly Unsatisfactory

2.3.2 Evaluation report format and review procedures

The report should be brief, to the point and easy to understand. It must explain; the purpose of the evaluation, exactly what was evaluated and the methods used. The report must highlight any methodological limitations, identify key concerns and present evidence-based findings, consequent conclusions, recommendations and lessons. The report should be presented in a way that makes the information accessible and comprehensible and include an executive summary that encapsulates the essence of the information contained in the report to facilitate dissemination and distillation of lessons.

The evaluation will rate the overall implementation success of the project and provide individual ratings of the eleven implementation aspects as described in Section 1 of this TOR. *The ratings will be presented in the format of a table* with brief justifications based on the findings of the main analysis.

Evidence, findings, conclusions and recommendations should be presented in a complete and balanced manner. Any dissident views in response to evaluation findings will be appended in an annex. The evaluation report shall be written in English, be of no more than 50 pages (excluding annexes), use numbered paragraphs and include:

i) An **executive summary** (no more than 3 pages) providing a brief overview of the main conclusions and recommendations of the evaluation;

ii) **Introduction and background** giving a brief overview of the evaluated project, for example, the objective and status of activities; The GEF Monitoring and Evaluation Policy, 2006, requires that a TE report will provide summary information on when the evaluation took place; places visited; who was involved; the key questions; and, the methodology.

iii) **Scope, objective and methods** presenting the evaluation's purpose, the evaluation criteria used and questions to be addressed;

iv) **Project Performance and Impact** providing *factual evidence* relevant to the questions asked by the evaluator and interpretations of such evidence. This is the main substantive section of the report. The evaluator should provide a commentary and analysis on all eleven evaluation aspects (A − K above).

v) **Conclusions and rating** of project implementation success giving the evaluator's concluding assessments and ratings of the project against given evaluation criteria and standards of performance. The conclusions should provide answers to questions about whether the project is considered good or bad, and whether the results are considered positive or negative. The ratings should be provided with a brief narrative comment in a table (see *Annex 1* to this Appendix);

vi) **Lessons (to be) learned** presenting general conclusions from the standpoint of the design and implementation of the project, based on good practices and successes or problems and mistakes. Lessons should have the potential for wider application and use. All lessons should 'stand alone' and should:

- Briefly describe the context from which they are derived
- State or imply some prescriptive action;
- Specify the contexts in which they may be applied (if possible, who when and where)

vii) **Recommendations** suggesting *actionable* proposals for improvement of the current project. In general, Terminal Evaluations are likely to have very few (perhaps two or three) actionable recommendations.

Prior to each recommendation, the issue(s) or problem(s) to be addressed by the recommendation should be clearly stated.

A high quality recommendation is an actionable proposal that is:

1. Feasible to implement within the timeframe and resources available

2. Commensurate with the available capacities of project team and partners

3. Specific in terms of who would do what and when

4. Contains results-based language (i.e. a measurable performance target)

5. Includes a trade-off analysis, when its implementation may require utilizing significant resources that would otherwise be used for other project purposes.

viii) **Annexes** may include additional material deemed relevant by the evaluator but must include:

1. The Evaluation Terms of Reference,

2. A list of interviewees, and evaluation timeline

3. A list of documents reviewed / consulted

4. Summary co-finance information and a statement of project expenditure by activity

5. The expertise of the evaluation team. (brief CV).

TE reports will also include any response / comments from the project management team and/or the country focal point regarding the evaluation findings or conclusions as an annex to the report, however, such will be appended to the report by UNEP EOU.

Examples of UNEP GEF Terminal Evaluation Reports are available at www.unep.org/eou

2.3.3 Review of the Draft Evaluation Report

Draft reports submitted to UNEP EOU are shared with the corresponding Programme or Project Officer and his or her supervisor for initial review and consultation. The DEWA staff and senior Executing Agency staff are allowed to comment on the draft evaluation report. They may provide feedback on any errors of fact and may highlight the significance of such errors in any conclusions. The consultation also seeks feedback on the proposed recommendations. UNEP EOU collates all review comments and provides them to the evaluators for their consideration in preparing the final version of the report.

2.3.4 Submission of Final Terminal Evaluation Reports.

The final report shall be submitted in electronic form in MS Word format and should be sent to the following persons:

Segbedzi Norgbey, Chief,
UNEP Evaluation and Oversight Unit
P.O. Box 30552-00100
Nairobi, Kenya
Tel.: +(254-20)762-4181
Fax: +(254-20)762-3158
Email: Segbedzi.Norgbey@unep.org

With a copy to:

XXXXXX
Director, Director, GEF Coordination Office
Block 2, North Wing, Ground Floor,
UNEP

P.O. Box 30552
Nairobi, Kenya
Tel: +(254-20)762-4166
Fax: +(254-702)116-176
Email:

Isabelle Vanderbeck
Task Manager
UNEP/DEPI GEF International Waters Unit
900 17th Street, N.W.
Washington, D.C. 20006

Tel: 202-974-1314
Email : isabelle.vanderbeck@unep.org

The final evaluation report will be published on the Evaluation and Oversight Unit's web-site www.unep.org/eou and may be printed in hard copy. Subsequently, the report will be sent to the GEF Office of Evaluation for their review, appraisal and inclusion on the GEF website.

2.4 Resources and schedule of the evaluation

This final evaluation will be undertaken by an international evaluator contracted by the Evaluation and Oversight Unit, UNEP. The contract for the evaluator will begin on ddmmyyy and end on ddmmyyyy (# days) spread over # weeks (# days of travel, to {country(ies)}, and # days desk study). The evaluator will submit a draft report on ddmmyyyy to UNEP/EOU, the UNEP Task Manager, and key representatives of the executing agencies. Any comments or responses to the draft report will be sent to UNEP / EOU for collation and the consultant will be advised of any necessary revisions. Comments to the final draft report will be sent to the consultant by ddmmyyyy after which, the consultant will submit the final report no later than ddmmyyyy.

The evaluator will, after an initial telephone briefing with EOU and UNEP/GEF, conduct initial desk review work and later travel to (country(ies)} and meet with project staff at the beginning of the evaluation. Furthermore, the evaluator may be expected to travel to {country(ies)} and meet with representatives of the demonstration activities and the intended users of project's outputs.

In accordance with UNEP/GEF policy, all GEF projects are evaluated by independent evaluators contracted as consultants by the EOU. The evaluator should have the following qualifications:

The evaluator should not have been associated with the design and implementation of the project in a paid capacity. The evaluator will work under the overall supervision of the Chief, Evaluation and Oversight Unit, UNEP. The evaluator should be an international expert in the global nitrogen cycle with a sound understanding of the provision of science to support policy issues. The consultant should have the following minimum qualifications: (i) experience in science of the nitrogen cycle; (ii) experience with management and implementation of international projects and in particular with science targeted at policy-influence and decision-making; (iii) experience with project evaluation. Knowledge of UNEP programmes and GEF activities is desirable. Fluency in oral and written English is a must.

2.4.1 Schedule Of Payment

The consultant shall select one of the following two contract options:

Lump-Sum Option

The evaluator will receive an initial payment of 30% of the total amount due upon signature of the contract. A further 30% will be paid upon submission of the draft report. A final payment of 40% will be made upon satisfactory completion of work. The fee is payable under the individual Special Service Agreement (SSA) of the evaluator and **is inclusive** of all expenses such as travel, accommodation and incidental expenses.

Fee-only Option

The evaluator will receive an initial payment of 40% of the total amount due upon signature of the contract. Final payment of 60% will be made upon satisfactory completion of work. The fee is payable under the individual SSAs of the evaluator and is **NOT** inclusive of all expenses such as travel, accommodation and incidental expenses. Ticket and subsistence expenses incurred will be paid separately.

In case, the evaluator cannot provide the products in accordance with the TORs, the timeframe agreed, or his products are substandard, the payment to the evaluator could be withheld, until such a time the products are modified to meet UNEP's standard. In case the evaluator fails to submit a satisfactory final product to UNEP, the product prepared by the evaluator may not constitute the evaluation report.

Annex 1 OVERALL RATINGS TABLE

Criterion	Evaluator's Summary Comments	Evaluator's Rating
A. Attainment of project objectives and results (overall rating) Sub criteria (below)		
A. 1. Effectiveness		
A. 2. Relevance		
A. 3. Efficiency		
B. Sustainability of Project outcomes (overall rating) Sub criteria (below)		
B. 1. Financial		
B. 2. Socio Political		
B. 3. Institutional framework and governance		
B. 4. Ecological		
C. Achievement of outputs and activities		
D. Monitoring and Evaluation (overall rating) Sub criteria (below)		
D. 1. M&E Design		
D. 2. M&E Plan Implementation (use for adaptive management)		
D. 3. Budgeting and Funding for M&E activities		
E. Catalytic Role		
F. Preparation and readiness		
G. Country ownership / drivenness		
H. Stakeholders involvement		
I. Financial planning		

Criterion	Evaluator's Summary Comments	Evaluator's Rating
J. Implementation approach		
K. UNEP Supervision and backstopping		

RATING OF PROJECT OBJECTIVES AND RESULTS

Highly Satisfactory (HS): The project had no shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Satisfactory (S): The project had minor shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Moderately Satisfactory (MS): The project had moderate shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Moderately Unsatisfactory (MU): The project had significant shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Unsatisfactory (U) The project had major shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Highly Unsatisfactory (HU): The project had severe shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Please note: Relevance and effectiveness will be considered as critical criteria. The overall rating of the project for achievement of objectives and results **may not be higher** than the lowest rating on either of these two criteria. Thus, to have an overall satisfactory rating for outcomes a project must have at least satisfactory ratings on both relevance and effectiveness.

RATINGS ON SUSTAINABILITY

Sustainability will be understood as the probability of continued long-term outcomes and impacts after the GEF project funding ends. The Terminal evaluation will identify and assess the key conditions or factors that are likely to contribute or undermine the persistence of benefits after the project ends. Some of these factors might be outcomes of the project, i.e. stronger institutional capacities, legal frameworks, socio-economic incentives /or public awareness. Other factors will include contextual circumstances or developments that are not outcomes of the project but that are relevant to the sustainability of outcomes.

Rating system for sustainability sub-criteria

On each of the dimensions of sustainability of the project outcomes will be rated as follows.

Likely (L): There are no risks affecting this dimension of sustainability.

Moderately Likely (ML). There are moderate risks that affect this dimension of sustainability.

Moderately Unlikely (MU): There are significant risks that affect this dimension of sustainability

Unlikely (U): There are severe risks that affect this dimension of sustainability.

According to the GEF Office of Evaluation, all the risk dimensions of sustainability are deemed critical. Therefore, overall rating for sustainability will not be higher than the rating of the dimension with lowest ratings. For example, if a project has an Unlikely rating in any of the dimensions then its overall rating cannot be higher than Unlikely, regardless of whether higher ratings in other dimensions of sustainability produce a higher average.

RATINGS OF PROJECT M&E

Monitoring is a continuing function that uses systematic collection of data on specified indicators to provide management and the main stakeholders of an ongoing project with indications of the extent of progress and achievement of objectives and progress in the use of allocated funds. Evaluation is the systematic and objective assessment of an on-going or completed project, its design, implementation and results. Project evaluation may involve the definition of appropriate standards, the examination of performance against those standards, and an assessment of actual and expected results.

The Project monitoring and evaluation system will be rated on ‘M&E Design’, ‘M&E Plan Implementation’ and ‘Budgeting and Funding for M&E activities’ as follows:

Highly Satisfactory (HS): There were no shortcomings in the project M&E system. Satisfactory(S): There were minor shortcomings in the project M&E system.

Moderately Satisfactory (MS): There were moderate shortcomings in the project M&E system.

Moderately Unsatisfactory (MU): There were significant shortcomings in the project M&E system.

Unsatisfactory (U): There were major shortcomings in the project M&E system.

Highly Unsatisfactory (HU): The Project had no M&E system.

“M&E plan implementation” will be considered a critical parameter for the overall assessment of the M&E system. The overall rating for the M&E systems will not be higher than the rating on “M&E plan implementation.”

All other ratings will be on the GEF six point scale.

GEF Performance Description		Alternative description on the same scale
HS	= Highly Satisfactory	Excellent
S	= Satisfactory	Well above average
MS	= Moderately Satisfactory	Average
MU	= Moderately Unsatisfactory	Below Average
U	= Unsatisfactory	Poor
HU	= Highly Unsatisfactory	Very poor (Appalling)

Annex 2 Co-financing and Leveraged Resources

Co financing (Type/Source)	IA own Financing (mill US$)		Government (mill US$)		Other* (mill US$)		Total (mill US$)		Total Disbursement (mill US$)	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
– Grants										
– Loans/Concessional (compared to market rate)										
– Credits										
– Equity investments										
– In-kind support										
– Other (*) - - - - -										
Totals										

Co-financing (basic data to be supplied to the consultant for verification)

* Other is referred to contributions mobilized for the project from other multilateral agencies, bilateral development cooperation agencies, NGOs, the private sector and beneficiaries.

Leveraged Resources

Leveraged resources are additional resources—beyond those committed to the project itself at the time of approval—that are mobilized later as a direct result of the project. Leveraged resources can be financial or in-kind and they may be from other donors, NGO's, foundations, governments, communities or the private sector. Please briefly describe the resources the project has leveraged since inception and indicate how these resources are contributing to the project's ultimate objective.

Table showing final actual project expenditure by activity to be supplied by the UNEP Fund management Officer.

Annex 3 Review of the Draft Report

Draft reports submitted to UNEP EOU are shared with the corresponding Programme or Project Officer and his or her supervisor for initial review and consultation. The GEF staff and senior Executing Agency staff provide comments on the draft evaluation report. They may provide feedback on any errors of fact and may highlight the significance of such errors in any conclusions. The consultation also seeks agreement on the findings and recommendations. UNEP EOU collates the review comments and provides them to the evaluators for their consideration in preparing the final version of the report. General comments on the draft report with respect to compliance with these TOR are shared with the reviewer.

Quality Assessment of the Evaluation Report

All UNEP GEF Mid Term Reports are subject to quality assessments by UNEP EOU. These apply GEF Office of Evaluation quality assessment and are used as a tool for providing structured feedback to the evaluator.

The quality of the draft evaluation report is assessed and rated against the following criteria:

GEF Report Quality Criteria	UNEP EOU Assessment	Rating
A. Did the report present an assessment of relevant outcomes and achievement of project objectives in the context of the focal area program indicators if applicable?		
B. Was the report consistent and the evidence complete and convincing and were the ratings substantiated when used?		
C. Did the report present a sound assessment of sustainability of outcomes?		
D. Were the lessons and recommendations supported by the evidence presented?		
E. Did the report include the actual project costs (total and per activity) and actual co-financing used?		
F. Did the report include an assessment of the quality of the project M&E system and its use for project management?		
UNEP EOU additional Report Quality Criteria	UNEP EOU Assessment	Rating
G. Quality of the lessons: Were lessons readily applicable in other contexts? Did they suggest prescriptive action?		
H. Quality of the recommendations: Did recommendations specify the actions necessary to correct existing conditions or improve operations (‘who?’ ‘what?’ ‘where?’ ‘when?)’. Can they be implemented? Did the recommendations specify a goal and an associated performance indicator?		

I. Was the report well written? (clear English language and grammar)		
J. Did the report structure follow EOU guidelines, were all requested Annexes included?		
K. Were all evaluation aspects specified in the TORs adequately addressed?		
L. Was the report delivered in a timely manner		

GEF Quality of the MTE report = 0.3*(A + B) + 0.1*(C+D+E+F)

EOU assessment of MTE report = 0.3*(G + H) + 0.1*(I+J+K+L)

Combined quality Rating = (2* 'GEF EO' rating + EOU rating)/3

The Totals are rounded and converted to the scale of HS to HU

Rating system for quality of terminal evaluation reports

A number rating 1-6 is used for each criterion: Highly Satisfactory = 6, Satisfactory = 5, Moderately Satisfactory = 4, Moderately Unsatisfactory = 3, Unsatisfactory = 2, Highly Unsatisfactory = 1, and unable to assess = 0.

Annex 4 GEF Minimum requirements for M&E

Minimum Requirement 1: Project Design of M&E[5]

All projects must include a concrete and fully budgeted monitoring and evaluation plan by the time of Work Program entry (full-sized projects) or CEO approval (medium-sized projects). This plan must contain at a minimum:

- SMART (see below) indicators for project implementation, or, if no indicators are identified, an alternative plan for monitoring that will deliver reliable and valid information to management
- SMART indicators for results (outcomes and, if applicable, impacts), and, where appropriate, corporate-level indicators
- A project baseline, with:
  - a description of the problem to address
  - indicator data
  - or, if major baseline indicators are not identified, an alternative plan for addressing this within one year of implementation
- An M&E Plan with identification of reviews and evaluations which will be undertaken, such as mid-term reviews or evaluations of activities
- An organizational setup and budgets for monitoring and evaluation.

Minimum Requirement 2: Application of Project M&E

- Project monitoring and supervision will include implementation of the M&E plan, comprising:
- Use of SMART indicators for implementation (or provision of a reasonable explanation if not used)
- Use of SMART indicators for results (or provision of a reasonable explanation if not used)
- Fully established baseline for the project and data compiled to review progress
- Evaluations are undertaken as planned
- Operational organizational setup for M&E and budgets spent as planned.

SMART INDICATORS GEF projects and programs should monitor using relevant performance indicators. The monitoring system should be “SMART”:

1. **Specific**: The system captures the essence of the desired result by clearly and directly relating to achieving an objective, and only that objective.
2. **Measurable:** The monitoring system and its indicators are unambiguously specified so that all parties agree on what the system covers and there are practical ways to measure the indicators and results.
3. **Achievable and Attributable:** The system identifies what changes are anticipated as a result of the intervention and whether the result(s) are realistic. Attribution requires that changes in the targeted developmental issue can be linked to the intervention.
4. **Relevant and Realistic:** The system establishes levels of performance that are likely to be achieved in a practical manner, and that reflect the expectations of stakeholders.
5. **Time-bound, Timely, Trackable, and Targeted:** The system allows progress to be tracked in a cost-effective manner at desired frequency for a set period, with clear identification of the particular stakeholder group to be impacted by the project or program.

[5] http://gefweb.org/MonitoringandEvaluation/MEPoliciesProcedures/MEPTools/meptstandards.html

Annex 5 List of intended additional recipients for the Terminal Evaluation (to be completed by the IA Task Manager)

Name	Affiliation	Email
Government Officials		
GEF Focal Point(s)		
Executing Agency		
Implementing Agency		

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 10

Decision Making Flow Chart and Organigrams

Table of Contents

1 Background

To ensure that the 'Towards INMS' project reaches its Objective as set out in the Pro-Doc, along with delivery of the necessary Outputs and Outcomes in pursuit of that Objective, a project governance and communication structure has been agreed with the partners. This structure will ensure good communication between all those involved in the project including the UNEP Task Manager and Project Management Board, who will provide general oversight. The Component, Activity and Task structure allows experts to focus on specific delivery of Task Outputs (in support of Project Outputs), but also to integrate across their work areas (at Activity or Component level), to ensure that information is shared effectively.

2 Overall Project Governance and Internal Communication

The overall project governance and internal communication flows within the 'Towards INMS' project are detailed in Figure A10.1. The general oversight of project activities will be undertaken by the **Project Management Board (PMB)**, which will allow project-level communication between the **Component Leaders**, the **Project Co-ordination Unit (PCU)**, the **Executing Agency (EA)** (i.e. NERC-CEH on behalf of INI) and the **Implementing Agency (IA)** (i.e. UNEP) . The PCU will undertake the day-to-day functions of the project, including maintaining communication between all parties in the project.

The work of the project will be reviewed and informed by the **Project Partners Assembly (PPA)**, which consists of representatives of all main partners (i.e. funding partners). It represents the overarching decision-making body. In addition, the project includes a **Stakeholder and Policy Advisory Group (SPAG)** to provide advice to the project and support wider dissemination. Members of the SPAG may also be Main Partners of the project, in which case they will also be members of the PPA. Members of the SPAG otherwise have **observer** status at the PPA. External communication from the project is further supported by Component 4, which includes focus on public engagement and awareness raising. In addition to the partnership itself, the PCU and Partners may also utilize **Consultants** to conduct specific aspects of the work. Such consultants have observer status at the PPA, being represented in decisions of the PPA by their relevant hosting Main Partner.

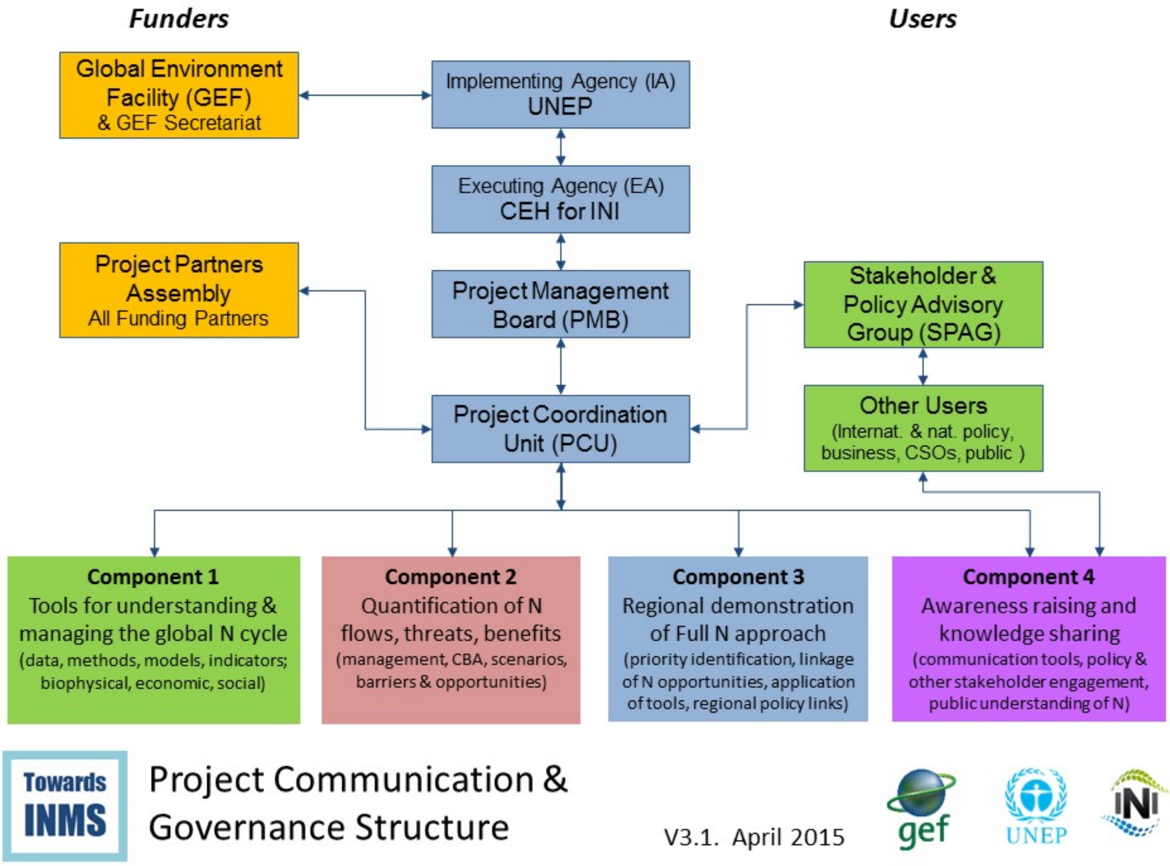

Figure A10.1: *Project governance and communication flow organigram.*

3 Responsibilities within the INMS Project

3.1 Implementing Agency (UNEP)

The Implementing Agency (IA) is UNEP, which is responsible to the GEF to ensure compliance with UNEP and the GEF requirements and that the project team (Executing Agency, Partners, Consultants, etc.) deliver the project to the quality and time-line agreed.

3.2 INI through NERC-CEH (Executing Agency)

The Executing Agency (EA) is the International Nitrogen Initiative as represented by the Centre for Ecology & Hydrology of the Natural Environment Research Council (NERC-CEH). NERC-CEH is a legally established non-departmental government body of the UK, as one of the UK Research Councils. The INI is the main global network of scientists addressing the nitrogen cycle at the science-policy interface.

The EA will be contracted by the IA to execute the project according to the approved Project Documents. The EA will be directly responsible for the PCU and will recruit appropriate experts to undertake the work. The EA will also be responsible for establishing the working arrangements with all the partners.

3.3 Project Management Board

The PMB will be established to oversee the activities of the project and to approve material (reports, outputs, etc.) for submission to the PPA, IA and to the GEF. The PMB will provide overall guidance to the project and will consist of IA, PCU (on behalf of the EA) and the Component Leaders. The GEF will be invited to nominate an Observer to the PMB. In order to avoid conflict of interest as project funder, GEF will cover its own costs in this role. The PMB will meet as required for the execution of the project, making full use of electronic conferencing facilities. The PMB will receive direction (consistent with the Pro-Doc/CEO) from the PPA, supported by advice from the SPAG acting as the executive of the Towards INMS Project.

Note that the PMB will not be expected to deal with day-to-day administration of the project, which will be handled by the Project Co-ordinator, Project Director and PCU (see Section 3.4), under guidance from the IA. This will ensure conformity with UNEP's and GEF's requirements.

The responsibilities of the PMB include:

- Oversee project
- Review and approve Work Plan [Appendix 5] & budget [Appendices 1&2] (for subsequent execution by PCU)
- Review and approve outputs
- Review and approve M&E outputs/reports
- Monitor progress and approve any changes
- Ensure focus of project is kept in-line with Goal and Objective
- Where necessary, the PMB will support definition of new targets in coordination with, and approval from, the Executing/Implementing Agencies
- Propose membership of the SPAG for confirmation by the PPA
- Meetings will make agreements by consensus subject to final approval by UNEP as the IA

Members:

- UNEP (as Implementing Agency)
- NERC-CEH (as Executing Agency and host of the PCU) on behalf of INI
- Component Leaders
- *Ad-hoc* invitations possible, for selected discussions.

Meetings:

- Meet as required for the execution of the project (including use of electronic conferencing facilities)

- Meet face-to-face once per year (e.g. back-to-back with the Inception and Project Partners Assembly Meetings)
- PCU act as secretariat (logistics, preparation and minutes)
- A Chair to be agreed by its members, for review annually

3.4 Project Co-ordination Unit (PCU)

The Project Co-ordination Unit (PCU) will be responsible for day-to-day project management and execution and will work closely with the project partners to ensure the objectives of this project are achieved. They will be responsible for providing the PPA, PMB, IA and the GEF with all management information and the required outputs from this project. The PCU will be responsible for the organisation of the Inception meeting and subsequent meetings of the Project Partners Assembly, and provide secretariat facilities for PMB, PPA and SPAG.

The PCU will consist of a Project Director (25% Full Time Equivalent, FTE), Project Co-ordinator (100% FTE), Technical support specialist (50% FTE), Project Management and Communications support will also be provided (up to 100% FTE, depending on staffing needs and availability), Financial support staff (25%). Terms of reference for these roles can be found in Appendix 11.

The responsibilities of the PCU include:

- Day-to-day administration and management of the project
- Provide all internal communication functions, e.g. to Component Leaders, PPA, SPAG through mailing lists and newsletters etc
- Collect and collate information on outputs from Task, Activity and Component Leaders
- Provide progress reports for PMB, PPA, SPAG
- Provide secretariat function for PMB, PPA, SPAG
- Provide necessary quarterly and annual reports for UNEP & GEF
- Maintain dialogue with UNEP Task Manager on progress and any arising issues

3.5 Project Partners

Two partner types are defined for the Towards INMS project, as follows:

Main Partners: Organisations who have provided co-financing through cash and in-kind contributions to the project. Main Partners may also take on ‘Co-ordinating’ and/or ‘Lead’ roles. Co-ordinating Partners are those within the Project Management Board (such as Component Leaders) and Lead Partners are responsible for the delivery of either an Activity or Task. As a contributor to project co-financing, each Main Partner is a full member of the PPA.

Associate Partners: Organisations who have not provided co-financing, but who have otherwise committed to contribute to or otherwise support the project.

The Partners are the organizations contributing to ‘Towards INMS’. Each organization will support the work through one or more of its staff, one of whom will be appointed by the Partner to be their Lead

Representative for 'Towards INMS' at the PPA (Lead Representatives of Main Partners would therefore be voting members of the PPA)

3.6 Project Partners Assembly

Towards INMS has around 80 Main Partners contributing funding resources to the project. Their involvement is critical and essential to the overall delivery of the project. Each Main Partner will be directly represented as part of the Project Partners Assembly (PPA), which will meet annually. As the aggregate of all funding partners, the PPA is the overarching decision making body of Towards INMS. Associate Partners (i.e. non-funding partners) contribute to the PPA as non-voting members. The PPA will support the execution of the project through the PMB and the PCU, who will report to the PPA annually. Members of the SPAG who are not Partners of INMS and other groups or individuals with an interest in INMS join the PPA as observers. As far as possible the PPA will take decisions by consensus.

The responsibilities of the PPA are to engage in execution of the project through annual meetings, review documents and make recommendations via the PCU to the PMB, more specifically:

- Review and approve Work Plan & budget (for subsequent execution by PCU)
- Review and approve outputs
- Review and approve M&E outputs/reports
- Confirm proposals for membership of the SPAG

Members:

- Main Partners*
- Associate Partners

*In cases where a consensus on recommendations cannot be found, the Lead Representative of each of the Main Partners will be asked to vote on their preferred option.

Meetings:

- Meet face-to-face once per year
- Further ad-hoc meetings (possibly by electronic conferencing) as required
- A Chair to be agreed by its members, for review annually

3.7 Stakeholder and Policy Advisory Group (SPAG)

A Stakeholder and Policy Advisory Group (SPAG) will be established during the INMS Inception Phase and will meet on an ad hoc basis. A proposal for membership will be made by the PMB for adoption or amendment by the PPA. The group will advise the PMB on scientific, policy and other stakeholder issues as needed to support development of options for an International Nitrogen Management System. The SPAG will be composed of differing expertise as the needs of the project evolve and may include Partners as well as other bodies and individual experts.

The responsibilities of the SPAG will include:

- Provide stakeholder advice on the strategy and progress of the project
- Review stakeholder focussed documents to ensure they are relevant and fit for purpose
- Respond to stakeholder consultations
- Provide feedback on project progress, outputs and messages by attending the Project Partners Assemblies and submitting oral/written reports to the PMB
- Meetings will make agreements by consensus and pass advisory recommendations to PMB via the PCU

Members:

- Scientific experts
- Business and industry representatives
- Civil society and NGO representatives
- Policy experts including government officials acting in an expert capacity

Meetings:

- Meet as required to advise the project (often virtually)
- Meet face-to-face once per year (e.g. alongside Inception and Project Partners Assembly Meetings)
- PCU act as secretariat (logistics, preparation and minutes)
- A Chair to be agreed by its members, for review annually

4 Structure of the Components

Project level communication and governance of the work of the Components will be directed by the PMB (Figure A10.1). Within each Component are a number of Activities (each delivering on one 'Output') and within these, several Tasks (each delivering on a 'Task Output').

To ensure effective delivery of the 'Outputs' and 'Outcomes' of the project, each Component, Activity and Task has been assigned a 'Leader' (in most cases two, allowing for flexibility and greater global representation). 'Terms of Reference' for each of these roles is included in Appendix 11. Component Leaders will be responsible for reporting back to the PCU and PMB on their progress and any issues which need to be addressed, including budget or Work Plan adjustments. Each of the Component Leaders will work with the Activity Leaders, Task Leaders and in the Case of Component 3 with the Demonstration Leaders, to constitute a Component Management Group (CMG). In Component 3, each of the Demonstrations will form a Demonstration Management Group (DMG) consisting of the Demonstration Leader and Task Leaders. The Component Leaders and Demonstration Leaders may invite additional experts to contribute as members of the CMGs and DMGs, respectively.

Figures A10.2-A10.5 outline the structure of each Component.

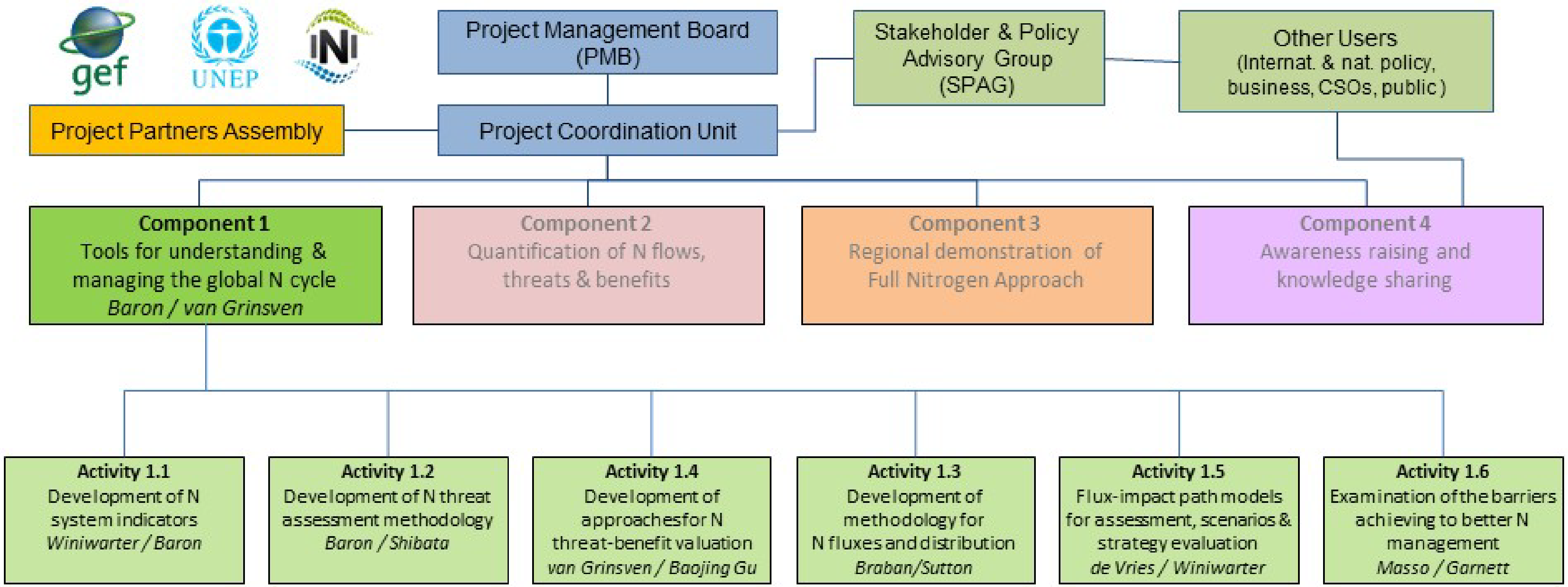

Figure A10.2: *Component 1 structure.*

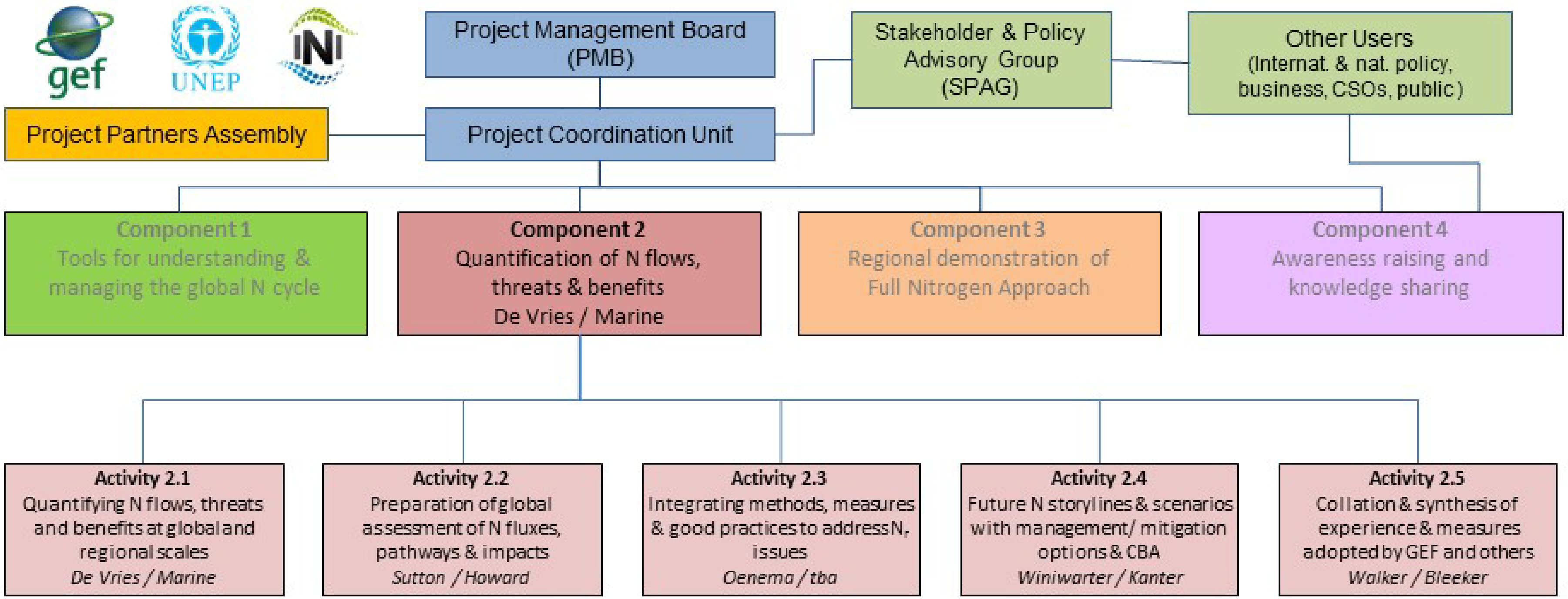

Figure A10.3: *Component 2 structure.*

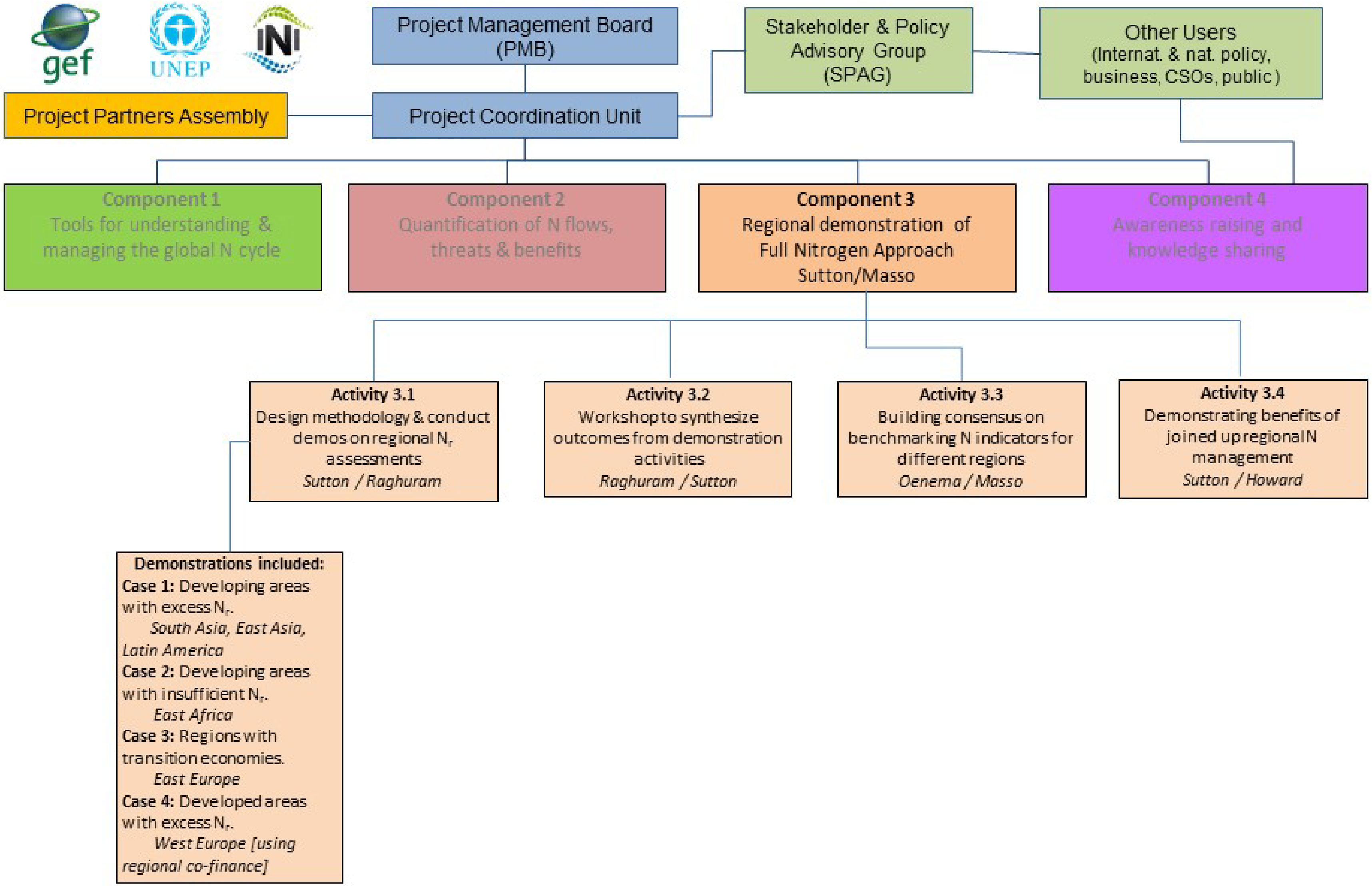

Figure A10.4: *Component 3 structure. Note for this component each of the Tasks in Activity 3.1 will take place in 5 demonstration regions, in parallel.*

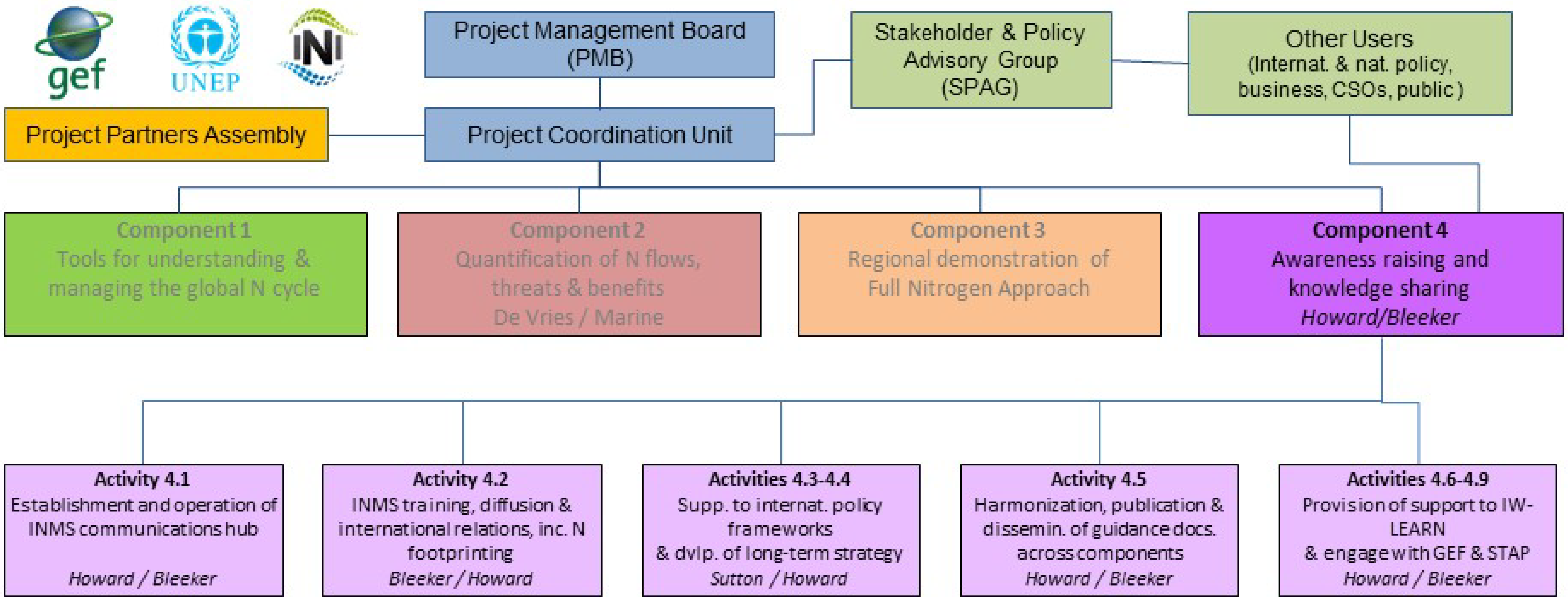

Table A10.5: *Component 4 structure, to Task Level.*

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 11

Agreements and Terms of References

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1 Project Cooperation Agreement (PCA)

PROJECT COOPERATION AGREEMENT (PCA)

FOR A

GLOBAL ENVIRONMENT FACILITY Full Size Project 'Targeted research for improving understanding of the global nitrogen cycle towards the establishment of an International Nitrogen Management System (INMS)'

This PROJECT COOPERATION AGREEMENT and its Appendixes (this "Agreement") is made:

BETWEEN: The United Nations Environment Programme (hereinafter referred to as "UNEP" and represented by its Director Division of Environmental Policy Implementation, an international inter-governmental organization established by the Project Partners Assembly of the United Nations, and having its office at P.O. Box 30552, Nairobi 00100, Kenya.

AND: International Nitrogen Initiative, hosted by the Natural Environment Council, Centre for Ecology & Hydrology (hereinafter referred to as "the Executing Agency"), a non-profit, public research organisation represented by its {position/title of representative} and having its office at Polaris House, North Star Avenue, Swindon, SN2 1EU, United Kingdom.

hereinafter collectively referred to as "the Parties".

WHEREAS, as a GEF Implementing Agency, and in accordance with the GEF Instrument, UNEP is accountable to the GEF Council for GEF-financed activities and to ensure that these are carried out in accordance with UNEP and GEF policies, criteria and procedures.

WHEREAS, Natural Environment Council, Centre for Ecology & Hydrology affirms that it is a non-profit, public research organisation and that it has the capacities required to carry out the activities outlined in this Agreement, and that the activities under this Agreement shall be carried out without discrimination of any nature.

Purpose

1. The Agreement sets forth the terms and conditions of the cooperation between the Parties for the execution of the project 'Targeted research for improving understanding of the global nitrogen cycle towards the establishment of an International Nitrogen Management System (INMS)' (hereinafter referred to as the "project") as fully described in the CEO Endorsement Document appended as **Appendix 1.** The project was approved by the UNEP Project Approval Group (PAG) on {date of Decision Sheet signature} and by the Global Environment Facility (GEF) Chief Executive Officer (CEO) in the letter dated {date of CEO letter} appended as **Appendix 2**.
2. The main objective of the project is to improve the understanding of the global/region N cycle and

investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems.

Interpretation

3. All Appendices appended to this Agreement shall be construed as an integral part of this Agreement.

4. Definitions of terms used in this Agreement are provided in **Appendix 3.**

Duration

5. This Agreement shall come into force upon signature by the Parties, being effective from the date of the latest signature, and shall remain in force until {ddmmyyyy}[1] after the last obligation of the Parties lapse, unless terminated earlier pursuant to clauses 52 to 63 of this Agreement. However, project effectiveness shall be the date of receipt by the Executing Agency of the first instalment of funds.

Cooperation

6. The Parties agree to cooperate with each other at all times and maintain close working relationships in order to achieve the objectives and outcomes of the project.

7. The Parties shall carry out their respective responsibilities in accordance with the provisions of this Agreement.

8. The Parties shall determine and communicate to each other the persons appointed as having the authority and responsibility for the project execution on its behalf.

9. Contact details for correspondence on substantive and technical matters as well as on administrative and financial matters are as set out in **Appendix 4**. Any changes to these contact details shall be communicated in a timely manner.

10. The Parties shall cooperate in any public relations or publicity exercises, when UNEP deems these appropriate or useful.

Cost of the project

11. The total cost of the project is US$ 62,575,907 of which 6,000,000 is GEF financing and the balance is co-financing as described below.

Cost to the GEF Trust Fund:	US$ 6,000,000
Cash contribution from the Executing Agency:	US$ 1,134,378
In-kind contribution from the Executing Agency:	US$ 3,820,322
Third party co-finance (cash):	US$ 9,840,622
Third party co-finance (in-kind):	US$ 41,780,585
Total cost of the project:	US$ 62,575,907

12. Detailed budget breakdown of GEF Funds and co-finance are included in Annex F-1 and Annex F-2

[1] To allow for receipt for all terminal reporting including the final audit report add 12 months (or less, if acceptable to EA) to the duration noted on approved CEO Endorsement Document .

of the project document which are appended hereto as **Appendix 1** to this document.

Terms and obligations of UNEP

13. With regard to project implementation, UNEP shall:

a) Provide, in its role as GEF Implementing Agency, project oversight to ensure that GEF policies and criteria are adhered to and that the project meets its objectives and achieves expected outcomes in an efficient and effective manner. Project supervision is entrusted to the Director, who discharges this responsibility through the assigned UNEP/GEF Task Manager and Fund Management Officer (refer to **Appendix 4**). Project supervision missions by the Task Manager and/or Fund Management Officer are outlined in the project supervision plan appended as **Appendix 5** to this document;
b) Have a representative on the Project management Board (see Section C of **Appendix 1**);
c) Perform the liaison function with the GEF Secretariat on the project;
d) Inform the GEF Secretariat whenever there is a potentially substantive co-financing change (i.e. one affecting the project objectives, the underlying concept, scale, scope, strategic priority, conformity with GEF criteria, likelihood of project success, or outcome of the project);
e) Rate, on an annual basis, progress in meeting project objectives, project implementation progress, risk, and quality of project monitoring and evaluation, and report to the GEF Secretariat through the Project implementation Review (PIR) report;
f) Review and clear manuscripts prepared by the Executing Agency before publication, and review and agree any publishing contracts;
g) Undertake a mid-term review or request the Evaluation Office (EO) of UNEP to perform an independent mid-term evaluation (see Section C of **Appendix 1**);
h) Ensure that EO arranges for an independent terminal evaluation and submits its report to the GEF Evaluation Office;
i) As deemed appropriate, facilitate access to information, advisory services, technical and professional support available to UNEP and will assist the Executing Agency to access the advisory services of other United Nations Organizations, whenever necessary.

14. With regard to cash advances, UNEP shall:

a) Provide all cash advances in US dollars up to the maximum amount of US$ 6,000,000 by way of periodic cash advances or by direct payment made by UNEP on behalf of the Executing Agency in accordance with the project budget. The first instalment of 40% shall be advanced to the Executing Agency within 2 weeks following signature of the present Agreement;
b) Advance the second and subsequent installments to the Executing Agency within 2 weeks after a financial report and other agreed-upon documentation, as referenced in clauses 34 and 37 of this Agreement, has been received by UNEP showing satisfactory progress of activities and adequate management and use of GEF resources;
c) Make the final disbursement of 5% of the total GEF-approved budget, upon submission and acceptance of the final report, outputs, final audited expenditure statement, co-finance report and final inventory of non-expendable equipment together with signed transfer agreement (if applicable). UNEP reserves the right to withhold the final payment in case of the Executing Agency's non-compliance of the abovementioned reporting obligations.

15. With regard to procurement, UNEP's clearance is required for the procurement of additional items costing above US$ 15,000 that are not included in the procurement plan. The same principle of clearance by UNEP shall apply to service contracts or agreements to be procured that are not in the

procurement plan and costing above US$ 30,000. UNEP may refuse to accept such expenditures being charged to the project budget in case of the Executing Agency's non-compliance of the abovementioned clearance obligation.

Terms and obligations of the Executing Agency

16. With regard to project execution, the Executing Agency shall:

a) Undertake to be bound by the terms and obligations specified below, and shall accordingly ensure that the personnel performing project-related activities under the present Agreement comply with these obligations;
b) Not seek nor accept instructions regarding the activities under the present Agreement from any Government or authority external to UNEP;
c) Refrain from any conduct that would adversely reflect on the United Nations and shall not engage in any activity which is incompatible with the aims and objectives of the United Nations or the mandate of UNEP;
d) Before disclosing confidential information, each Party will obtain the express, written consent of the other party. In any event, such confidential information shall not be used for individual profit. The Executing Agency's focal point for this project may communicate with the media regarding the methods and scientific procedures used by the Executing Agency. However, UNEP clearance is required for the use of UNEP's name in conjunction with project activities in accordance with clause 46 of this Agreement. The Executing Agency must adhere to the GEF Communication and Visibility Policy, including the Brand Guidelines and Graphics Standards of the GEF (www.thegef.org). This obligation shall not lapse upon termination of the present Agreement unless otherwise agreed between the Parties;
e) Inform UNEP in writing whenever there is a potentially substantive co-financing change;
f) Notify UNEP, in writing, about any expected variations on the project budget on an annual basis;
g) With regard to subcontracts between the Executing Agency and its contractor(s), the Executing Agency shall:
   - ✓Establish all subcontracts in writing which includes but is not limited to reporting and audit obligations which flow down in the subcontracts;
   - ✓Maintain primary responsibility for ensuring successful completion of the project. This responsibility cannot be delegated or transferred to the Executing Agency's contractor(s);
   - ✓Monitor the performance of their contractors and ensure that they comply with all applicable terms and conditions of their Agreement.

17. With regard to personnel administration, the Executing Agency shall be solely and completely responsible and accountable for all services performed by its personnel, agents, employees, or contractors (hereinafter referred to as "Personnel").

18. Personnel of the Executing Agency, its contractors or anyone else working for the Executing Agency in the execution of the project or otherwise, are not employees of UNEP and are not covered by the privileges and immunities applying to UNEP and its staff pursuant to the Convention on the Privileges and Immunities of the United Nations. UNEP shall not accept any liability for claims arising out of the activities performed under the Agreement, or any claims for death, bodily injury, disability, damage to property or other hazards that may be suffered by the Executing Agency's Personnel as a result of their work pertaining to the project under this Agreement.

19. The Executing Agency shall ensure that its Personnel meet the highest standards of qualification and technical and professional competence necessary for the achievement of the objectives and results of the Project, and that decisions on employment related to the Project shall be free of

discrimination of any nature. The Executing Agency shall ensure that all Personnel are free from any conflicts of interest relative to the project activities and they shall comply with their national statutory requirements.

20. The Executing Agency shall recruit the respective senior project personnel in accordance with the terms of reference set out in (refer to the specific appendices) of the project document appended as **Appendix 1** to this document.

21. In the event that the Executing Agency assigns or seconds its existing employee to the project, the terms of reference and contractual conditions pertaining to the assignment/secondment shall be shared with UNEP, including the amount and source(s) of remuneration and the time allocated to perform the duties assigned within the framework of the project.

22. With regard to procurement, the Executing Agency shall:

   a) Ensure that procurement of goods and consulting services financed by GEF funds shall be subject to rules and regulations of the Executing Agency and include written standards based on widely recognized processes and an internal control framework to protect against fraud, corruption and waste;
   b) Ensure that, in its procedures for procurement of goods, services or other requirements with funds made available by GEF as provided for in the project document, it shall safeguard the principles of highest quality, economy and efficiency, and that the placing of such orders be based on an assessment of competitive quotations, bids, or proposals unless otherwise agreed to with UNEP.

23. Before the commencement of procurement, furnish the project procurement plan to be reviewed at the project inception meeting and cleared by UNEP.

24. Utilize the funds and any supplies and equipment provided by UNEP in full compliance with the project document.

25. Maintain complete and accurate records of non-expendable equipment purchased with GEF project funds and a duly authorized official of the Executing Agency shall take periodic physical inventories. Within 1 month of the year ending 31 December, i.e. on or before 31 January, the Executing Agency shall provide UNEP annually with the inventory of such non-expendable equipment as at 31 December, using the format appended as **Appendix 8A** to this document.

26. Be responsible for the proper custody, maintenance and care of all non-expendable equipment as well as items of attraction (items costing less than US$ 1,500, but with a useful life of more than a year) purchased with GEF funds. The Executing Agency shall, for the protection of such equipment and materials during implementation of the project, obtain appropriate insurance in such amounts as incorporated in the project budget.

27. In cases of damage, theft or other losses of property made available to the Executing Agency, provide UNEP with a comprehensive report, including police report, where appropriate, and any other evidence giving full details of the events leading to the loss of the property.

28. Obtain authorization of UNEP, in case the Executing Agency intends to dispose of the equipment during the duration of the project. Within 2 months of the project operational completion date or upon termination of this Agreement, the Executing Agency shall submit a final inventory of equipment to UNEP and a proposal for the disposal/transfer of the said equipment using the format appended as **Appendix 8B** to this document, unless otherwise agreed upon between the Parties.

29. With regard to cash advances, the Executing Agency shall:

a) Provide the banking details to UNEP on the Third Party Form appended as **Appendix 9A** to this document;
b) Requests for subsequent cash advances using the formats appended as **Appendix 9B** to this document;
c) Comply with the reporting requirements as referenced in clauses 34 and 37 of this Agreement, failing which, UNEP may withhold further disbursements or may suspend the project until such time the Executing Agency meets its financial and operational obligations;
d) Confirm at least two weeks before the payment is due, that the expected rate of expenditure and actual cash position necessitate the payment, including a reasonable amount to cover "lead time" for the next remittance.

30. With regard to cost overruns, the Executing Agency shall ensure that, under this Agreement, total expenditures incurred by the Executing Agency do not exceed the GEF-approved budget as set out in clauses 11 and 12 of this Agreement. The Executing Agency shall be authorized to make variations not exceeding 50 per cent on any one line item of the project budget provided that the total allocated for that specific budget Component by UNEP is not exceeded. Any variations exceeding 50 per cent on any one line item that may be necessary for the proper and successful execution of the project shall be subject to prior consultations with and approval by UNEP. In such a case, a revision to the project document amending the budget shall be issued by UNEP. In the absence of such approval by UNEP, cost overruns shall be the sole responsibility of the Executing Agency.

31. With regard to project management cost, the Executing Agency shall ensure that project management costs for the Executing Agency do not exceed the GEF-approved amount in project budget in accordance with GEF rules. Any increase in management costs as a result of extending the duration of the project shall be the sole responsibility of the Executing Agency.

32. With regard to maintenance of records:

a) The Executing Agency shall keep separate, accurate and up-to-date records and documents in respect of all expenditures incurred with the funds made available by UNEP to ensure that all expenditures are in conformity with the provisions of the project document. For each disbursement, proper supporting documentation shall be maintained, including original invoices, bills, and receipts pertinent to the transaction;
b) Upon operational completion of the project or termination of this Agreement, the Executing Agency shall maintain all records pertinent to the project for a period of at least 3 years unless otherwise agreed upon between the Parties.

33. With regard to unspent balances, should there remain a balance from the total GEF-approved budget after operational completion or termination of the project, the Executing Agency shall return the unspent funds to UNEP within 2 months of the expiry or termination of this Agreement. In the event that there is any delay in such disbursement, the Executing Agency will be financially responsible for any adverse movement in the exchange rates. If any of the financial, substantive and evaluation reports indicate that the funds provided under this PCA were not used for its intended purposes due to: a) Executing Agency's actions; and/ or b) action of a third party as a result of Executing Agency's gross negligence or willful misconduct, the Executing Agency shall promptly return to UNEP the amount of GEF resources indicated by such report as not having been used for the intended purposes provided under the PCA.

34. With regard to reporting:

a) The Executing Agency shall_provide all reports, including the audit report, for the project in English or translated to English as applicable;

b) Progress report: Within 1 month of the end of reporting period, i.e. on or before 31 January, the Executing Agency shall submit to UNEP a half-yearly progress report for the period July-December using the format appended as **Appendix 10** of this document;
c) Project Implementation Review (PIR) report: Within 1 month of the end of the reporting period for the GEF fiscal year of 30 June, i.e., on or before 31 July, the Executing Agency shall submit to UNEP its input to the annual PIR report using the format appended as **Appendix 11** of this document. The PIR report shall be accepted as the progress report for the period January-June;
d) Final report: Using the format appended as **Appendix 12** of this document, a draft copy of the Final Report shall be submitted by the Executing Agency to UNEP at the time of operational completion of the project. Within 2 months of the project operational completion, or termination of the present Agreement, the Executing Agency shall submit to UNEP a final copy of the afore-mentioned report. The quality of Final Report shall be assessed by the terminal Evaluation of the project.
e) Financial report: All financial reporting shall be in US dollars, and any exchange differences accounted for within the total GEF-approved US dollar project budget. Within 1 month of the end of the quarter to which they refer, i.e., on or before 30 April, 31 July, 31 October and 31 January, the Executing Agency shall submit to UNEP quarterly expenditure reports and explanatory notes on the expenditures reported using the format appended as **Appendix 13** of this document. The financial report shall contain information that forms the basis of a periodic financial review and its timely submission is a prerequisite to the continuing funding of the project. UNEP will act upon requests for advances of funds only upon its receipt and acceptance of a satisfactory financial and progress reports from the Executing Agency;
f) The Executing Agency shall submit to UNEP a signed final statement of accounts within 3 months of operational completion of project activities. The final statement of accounts shall be prepared using the format appended as **Appendix 13** of this document;
g) Basis of accounting: The financial report has been designed to reflect the transactions of a project on a cash basis, and thus shall include only disbursements made by the Executing Agency and not commitments;
h) Miscellaneous Income: The Executing Agency shall credit any miscellaneous income to the project accounts as a receipt of funds against agreed project requirements. Miscellaneous income shall include, inter alia, proceeds or receivable from the sale of any item or property provided under the project governed by this Agreement, as well as any bank interest earned or accrued on project funds remitted by UNEP and which have been deposited or temporarily placed in an interest–bearing account;
i) Refund from sub-contractor: Any refund received by the Executing Agency from a supplier/third party shall be reflected in the financial report as a reduction of disbursements on the component to which it relates;
j) Co-financing report: Within 1 month of the PIR reporting period, i.e. on or before 31 July, the Executing Agency shall submit to UNEP, an annual co-financing report for the project as at 30 June showing amount of cash and in-kind co-financing realized compared to the amount of co-financing committed to at the time of the project approval in accordance with Annex F-2 of the project document appended as **Appendix 1** of this document. Co-financing reporting shall be by source using the format appended as **Appendix 14** of this document;
k) Third party co-financing reporting: The Executing Agency shall ensure that the legal instruments prepared with its project partners require partners to report, on an annual basis, the actual co-financing received versus committed at the time of project approval by the GEF, and provide assurances that the identified in-kind resources be:
    - ✓ Dedicated specifically to the GEF project;

- ✓ Valued at the lower of cost or market value of the required inputs they provide for the project;
- ✓ Monitored with documentation available for any project evaluation;

l) Consolidated reporting: All reports described above shall be consolidated reports and therefore include information from any third party sub-project(s).

Financial cost

35. UNEP shall not be liable for the payment of any expenses not outlined in the project document or project budget unless UNEP has explicitly agreed in writing to do so prior to the expenditure by the Executing Agency.

Audit requirements

36. All financial reporting in the audit report shall be in US dollars and shall be conducted annually.

37. The total expenditures incurred during the year ending 31 March, wherein GEF funding is clearly identified, shall be endorsed by a duly authorized official of the Executing Agency and audited by an independent audit authority and dispatched to UNEP within 183 days, i.e. on or before 30 September. The audit report and recommendations shall include such comments as the auditor may deem appropriate in respect of GEF funded operations and in particular, shall clearly indicate that in their opinion:

a) GEF funds were covered by the scope of the audit;
b) Proper books of account have been maintained;
c) All project expenditures are supported by vouchers and adequate documentation;
d) Expenditures have been incurred in accordance with the objectives outlined in the project document;
e) The expenditure reports provide a true and fair view of the financial condition and performance of the project.

On operational completion of the project, a final audited statement of account containing signatures and audit opinion as required above, shall be dispatched to UNEP within 6 months.

38. Notwithstanding the above, UNEP shall have the right, at its own expense, to audit or review such books and records as it may require, and have access to the books and record of the Executing Agency, as necessary. If requested, the Executing Agency shall facilitate an audit by the United Nations Office of Internal Oversight Services. Shall they wish to do so, the United Nations Board of Auditors may also carry out an audit of the project accounts.

Responsibility for claims

39. The Executing Agency shall indemnify, hold, and save harmless, and defend at its own expense, UNEP, its officials and persons performing services for UNEP, from and against all suits, claims, demands and liability of any nature and kind, including their cost and expenses up to the value of US dollars 12,000,000, consistent with UK Government policy, arising out of acts or omissions of the Executing Agency or its employees or persons hired for the management of the present Agreement and the project

40. The Executing Agency shall be responsible for, and deal with all claims brought against it by its personnel, employees, agents or subcontractors.

Publications, acknowledgements, logos and emblems

41. The Executing Agency shall submit to UNEP for review and prior clearance of any manuscripts for

publication. It shall also inform UNEP of plans for its publication and discuss and agree on the publishing arrangements. Within 30 days of receipt, UNEP will provide substantive comments on/clearance of the manuscript. UNEP's review will include any suggestions for change and such wording (recognition, disclaimer, etc.) as it would wish to see figure in the preliminary pages or in the introductory texts. It will equally consider the publishing proposal of Executing Agency and will make comments thereon as advisable.

42. To accord proper acknowledgement to the GEF for providing funding to the project, any publications prepared or produced pursuant to this Agreement will give appropriate credit to GEF as per the GEF Communication and Visibility Policy, including the Brand Guidelines and Graphics Standards (www.thegef.org) in addition to that of UNEP as stipulated under clause 46 of this Agreement. Any citation on project publications of projects funded by GEF resources shall also accord proper acknowledgement to GEF and UNEP.

43. The GEF logo shall appear on, amongst others, project hardware and vehicles purchased with GEF funds.

44. In no event will authorization of the name or emblem, or any abbreviation thereof, of GEF or UNEP, be granted for commercial purposes.

45. Should the Executing Agency be solely responsible for publishing arrangements of documents specified in the Project Document (Appendix 1 to CEO Endorsement Document), UNEP shall receive free of charge at least 5 copies of the published work in each of the languages, for non-commercial purposes.

46. The Executing Agency may only use the name and emblem of the United Nations or UNEP with prior written consent of UNEP.

Intellectual property rights

47. For the purpose of this Agreement, intellectual property would mean information, ideas, inventions, innovations, art work, data, designs, literary texts and any other matter or thing whatsoever as may be capable of legal protection or be subject to legal rights and shall include patents; information which is of a kind that has been communicated in such a manner as to give rise to a duty of confidentiality; copyright vesting in literary works (including but not limited to computer programs); dramatic works, musical works, broadcast, published editions and other types of performance; registered trademarks; unregistered trademarks used or intended for use in business registered designs and designs capable of being registered; biological organism varieties and the rights of breeders of such varieties; layout design of integrated circuits; databases; and any other rights resulting from intellectual activity in the industrial, commercial, scientific, literary and artistic fields.

48. UNEP and the Executing Agency shall agree upon the question of copyrights and all other related rights in any material produced under the provisions of this Agreement.

Confidentiality

49. The handling of information will be subject to each Party's corporate confidentiality policies.

50. Before disclosing internal documents, or documents that by virtue of their content or the circumstances of their creation or communication must be deemed confidential, of the other [or another] Party to third parties, each Party will obtain the express, written consent of the other Party [or concerned Parties]. However, a Party's disclosure of another Party's internal and/or confidential documents to an entity the disclosing Party controls or with which it is under common

control, or to an entity with which it has a confidentiality agreement, will not be considered a disclosure to a third party, and will not require prior authorization.

51. For UNEP, a principal or subsidiary organ of the United Nations established in accordance with the Charter of the United Nations will be deemed to be a legal entity under common control.

Suspension and termination

52. The Parties hereto recognize that the successful completion and accomplishment of the purposes of a technical cooperation activity are of paramount importance, and that UNEP may find it necessary to terminate the project, or to modify the arrangements for the management of the project, should circumstances arise that jeopardize successful completion or the accomplishment of the purposes of the project within the approved duration of the project.

53. UNEP shall consult with the Executing Agency if any circumstances arise that, in the judgment of UNEP, interfere or threaten to interfere with the successful operational completion of the project or the accomplishment of its purposes. The Executing Agency shall promptly inform UNEP of any such circumstances that might come to its attention. The Parties shall cooperate towards the rectification or elimination of the circumstances in question and shall exert all reasonable efforts to that end, including prompt corrective steps by the Executing Agency, where such circumstances are attributable to it or within its responsibility or control.

54. At any stage of the project cycle, participating country(ies), UNEP or the GEF Secretariat may recommend suspending or terminating the project for several reasons including force majeure, changes in national priorities, poor implementation performance, lack of compliance with financial or reporting obligations, leading to a conclusion that the project can no longer meet its objectives.

55. Following receipt of a recommendation for suspension or termination, and after appropriate consultations, UNEP may suspend or terminate the project by written notice to the Executing Agency. In the event of termination, such notice shall be provided at least 3 months prior to the effective date. If it is a suspension, UNEP shall indicate to the Executing Agency the conditions under which it is prepared to authorize project activities to resume.

56. If the cause of suspension is not rectified or eliminated within the timeframe, as agreed between UNEP and the Executing Agency, after UNEP has given notice of suspension to the Executing Agency, UNEP may, by written notice at any time thereafter during the continuation of such cause: (a) terminate the project; or (b) terminate the management of the project by the Executing Agency, and entrust its management to another institution. The effective date of termination under the provisions of the present clause shall be specified by written notice from UNEP.

57. The Executing Agency may terminate the present Agreement in cases where a condition has arisen that impedes the Executing Agency from successfully fulfilling its responsibilities under the present Agreement, by providing UNEP with written notice of its intention to terminate the present Agreement at least 3 months prior to such termination.

58. The Executing Agency may terminate the present Agreement only after consultations have been held with UNEP, and shall give due consideration to proposals made by UNEP in this respect. The Parties shall also cooperate in assessing the consequences on the other partners and beneficiaries of the project, and develop and agree upon an exit strategy to minimize negative consequences.

59. Upon receipt of a notice of termination by either party under clauses 55 to 58 of this Agreement, The Parties shall take immediate steps to terminate activities under the present Agreement, in a prompt and orderly manner, so as to minimize losses and further expenditures. The Executing Agency shall undertake no forward commitments and shall return to UNEP, within 2 months of the

effective date of termination, all unspent funds, provided by UNEP unless UNEP has agreed otherwise in writing.

60. In the event of any termination by either party under clause 59 of this Agreement, UNEP shall reimburse the Executing Agency only for the costs incurred to manage the project in conformity with the express terms of the present Agreement. Reimbursements to the Executing Agency under this provision, when added to amounts previously remitted to it by UNEP in respect of the project, shall not exceed the total UNEP allocation/contribution for the project.

61. In the event of transfer of the responsibilities of the Executing Agency for the management of a project to another institution, the Executing Agency shall cooperate with UNEP and the other institution in the orderly transfer of such responsibilities and equipment procured using project funds.

Force majeure

62. In the event of and as soon as possible after the occurrence of any cause constituting force majeure, the party affected by the force majeure shall give the other party notice and full particulars in writing of such occurrence if the affected party is thereby rendered unable, in whole or in part, to perform its obligations or meet its responsibilities under the present Agreement. The Parties shall consult on the appropriate action to be taken, which may include suspension of the present Agreement by UNEP or termination of this Agreement, with either party giving to the other at least 1 month written notice of such termination.

63. In the event that the present Agreement is terminated owing to causes constituting *force majeure*, the provisions of clauses 60 and 61 of this Agreement shall apply.

Dispute settlement

64. The Parties shall settle amicably through direct negotiations, any dispute, controversy or claim arising out of or relating to the present Agreement, including breach and termination of the Agreement. Should such negotiations fail, the matter shall be referred to arbitration in accordance with United Nations Commission on International Trade Law Arbitration Rules (UNCITRAL), then prevailing. The Parties shall be bound by the arbitration award rendered in accordance with such arbitration, as the final decision on any such dispute, controversy or claim.

Privileges and immunities

65. Nothing in or relating to this Agreement shall be deemed a waiver, express or implied, of any of the privileges and immunities of the United Nations and UNEP.

Notification and amendments

66. Any part of this Agreement may be modified or amended only by written agreement between the Parties.

67. For multi-country projects, in the event that one or more countries withdraw from the project, the Executing Agency shall inform UNEP which shall in turn notify the GEF Secretariat.

68. Should it become evident during the implementation of the project that an extension beyond the agreed expiry date as set out in clause 5 of this Agreement is required to achieve the objectives of the project, the Parties shall consult with each other with a view to agree on a revised completion date. In the event that the duration of the project is extended, clauses 30 and 31 of this Agreement shall apply. Upon reaching an agreement, the Parties shall immediately conclude an amendment to the Agreement to this effect, prior to the expiry of this Agreement.

69. The terms and conditions stipulated in the amendment shall be appended to and be construed as an integral part of this Agreement.

IN WITNESS WHEREOF, the duly authorized representatives of the Parties affix their signatures below.

For:	For:
United Nations Environment Programme	{Executing Agency}
By: ______________________	By: _________________________
………	{Name}
Director,	
Division of ……..	NERC Centre for Ecology & Hydrology
UNEP	
Date: ______________________	Date: _________________________

LIST OF APPENDICES TO THE PROJECT COOPERATION AGREEMENT

Appendix 1	Approved CEO Endorsement Document (including Annexes)
Appendix 2	CEO approval/endorsement letter
Appendix 3	Definition of terms
Appendix 4	Contact details
Appendix 5	Draft project supervision plan
Appendix 6	Procurement Plan
Appendix 7	ToRs for Key Personnel
Appendix 8A	Inventory of Non-expendable Equipment Report Template
Appendix 8B	Non-expendable Equipment Ownership Transfer Letter Template
Appendix 9A	Third Party Form Template
Appendix 9B	Cash Advance Request Template
Appendix 10	Progress Report Template
Appendix 11	Project Implementation Review (PIR) Report Template
Appendix 12	Final Report template
Appendix 13	Quarterly Expenditure Statement template

Appendix 14 Co-finance Report Template

2 NERC-CEH Model Contract

Subcontract

PROJECT TITLE

NEC

Subcontract

This agreement is made on INSERT DATE

Between

(1) The Natural Environment Research Council as represented by its component body the Centre for Ecology and Hydrology of Polaris House, North Star Avenue Swindon, SE2 1EU "CEH";

(2) SUBCONTRACTOR NAME AND ADDRESS "Subcontractor";

Recitals

(A) Background to the project
(B) This agreement comprises of these terms, Schedule 1 and the main contract in Schedule 2.

1. DEFINITIONS

"Background Intellectual Property" shall mean any Intellectual Property excluding Foreground Intellectual Property owned or controlled by any Party prior to commencement of or independently from the Project, and which the owning Party contributes or uses in the course of performing the Project;

"Confidential Information" shall mean any information or data including, but not limited to, business, commercial, technical, operational, management, financial and sales data (both historical and current), performance data, employment details for employees, ideas, reports, plans, passwords, documents, drawings, graphics, designs, methods, processes, systems, software programs, writings, samples, models, materials, databases, management accounts, know-how, Intellectual Property Rights and information relating to products, marketing activities, customers, and working practices or otherwise disclosed in any form whatsoever (including, but not limited to, disclosure made orally or in writing, whether electronic, digital or other formats and whether or not in readable media) by one Party (the "Disclosing Party") to the other (the "Receiving Party") in connection with or as a consequence of the Purpose irrespective of whether such information is marked as confidential any Background Intellectual Property disclosed by one Party to the other for use in the Project and any Foreground Intellectual Property in which that Party owns the Intellectual Property;

"Foreground Intellectual Property" shall mean any Intellectual Property which is generated or first reduced to practice by any Party or Parties directly as a result of the work undertaken in accordance with this agreement;

"FOIA'' means the Freedom of Information Act 2000 and the Freedom of Information (Scotland) Act 2002 and any subordinate legislation made under that Act from time to time together with any guidance and/or codes of practice issued by the Information Commissioner or relevant government department in relation to such legislation;

"Intellectual Property" shall mean intellectual property of any description including but not limited to all inventions, designs, information, specifications, formulae, improvements, discoveries, know-how, data, processes, methods, techniques and the intellectual property rights therein, including but not limited to, patents, copyrights, database rights, design rights (registered and unregistered), trade marks, trade names and service marks, applications for any of the above.

A "**Party**" means any Party to this agreement individually and "**Parties**" refers to all of the Parties to this agreement collectively. A Party shall include all permitted assigns of the Party in question;

"Project" means the project which this agreement is intended to deliver. The project details, obligations of the parties and overarching principles of the relationship are more specifically detailed in Schedule 1;

"Project Manager" shall mean the person appointed by CEH to manage the Project. The Project Manager shall be NAME;

"Scope of Work" shall mean the tasks and/or detailed in Schedule 1.

"Main contract" shall mean the Project Cooperation Agreement between CEH as the Executing Agency of "Towards INMS" and the United Nations Environment Programme as the Implementing Agency of "Towards INMS".

"Towards INMS" shall mean the full size project financed through the Global Environment Facility entitled: Targeted research for improving understanding of the global nitrogen cycle towards the establishment of an International Nitrogen Management System (INMS)".

1. TERMS

The terms of the main contract detailed in Schedule 2 will apply. The Subcontractor undertakes to observe the terms and conditions of the main contract so far as they relate to the Scope of Work. Signature of this agreement indicates acceptance of the terms of the main contract detailed in Schedule 2. For the avoidance of doubt, where there is a conflict between the terms of the main agreement (Schedule 2) and this subcontract, the terms of the main agreement will prevail.

2. **DURATION**

The programme of research will start on **START DATE** and shall be completed by **END DATE**.

3. COST

The approved cost of the programme (including any Value Added Tax if applicable) is £???.

5. PAYMENT

Payment for the above mentioned sums will be made quarterly in arrears on receipt of a statement of expenditure from the Subcontractor of all expenditure properly incurred during that period. Payment of expenditure will be made within 30 days of receipt of invoice and satisfactory completion of the Scope of Work to which it relates. All invoices should quote Project Number NEC0???? and the Purchase Order number. The Purchase Order number will be supplied to the Subcontractor by the Project Manager following signature of the agreement by both Parties.

Or PAYMENT AT END – CHOOSE WHICH ONE

Payment for the above mentioned sums will be made in arrears on completion of the Scope of Work carried out and on receipt of an invoice and statement of expenditure from the Subcontractor detailing all expenditure properly incurred during that contract period. Payment of expenditure will be made within 30 days of receipt of invoice and satisfactory completion of the Schedule of Work. All invoices should quote Project Number

NEC0???? and the Purchase Order number. The Purchase Order number will be supplied to the Subcontractor by the Project Manager following signature of the agreement by both Parties.

Or PAYMENT ACCORDING TO SCHEDULE – CHOOSE WHICH ONE

Payment for the above mentioned sums will be made in accordance with the payment schedule (Schedule 3) for work carried out and on receipt of an invoice and statement of expenditure from the Subcontractor detailing all expenditure properly incurred during that contract period. Payment of expenditure will be made within 30 days of receipt of invoice and satisfactory completion of the Scope of Work. All invoices should quote Project Number NEC0????? and the Purchase Order number. The Purchase Order number will be supplied to the Subcontractor by the Project Manager following signature of the agreement by both Parties.

If you are registered on the isupplier system invoices should be uploaded on to there. Otherwise Invoices for payment should be sent to:-

NERC, RCUK Shared Services Centre Ltd, Polaris House, North Star Avenue.
Swindon, SN2 1EU

Or

Finance@ssc.rcuk.ac.uk.

6. TERMINATION

6.1 CEH may terminate this contract forthwith by notice to the Subcontractor if the latter fails to observe or perform any of its obligations under this contract and has been notified in writing by CEH of the nature of the failure and omits to remedy such failure within such reasonable period as specified in such notice.

6.2 In the event of premature termination, the Subcontractor shall provide CEH with such reports as it may require within one month of the date of termination.

6.3 CEH will make payment to the Subcontractor of costs properly incurred in carrying out the Project up to the date of termination. CEH's liability under this clause shall not in any circumstances exceed the Contract price (detailed in Clause 4) that would have been payable had the Contract not been terminated.

7. INTELLECTUAL PROPERTY RIGHTS

7.1 CEH will own all Foreground Intellectual Property created by the Subcontractor in the performance of the Project.

7.2 Any existing Background Intellectual Property used in the provision of the services will remain the property of the Party introducing it.

7.3 Each Party grants the others a royalty-free, non-exclusive licence for the duration of the Project to use its Background Intellectual Property for the sole purpose of carrying out the Project. No Party may grant any sub-licence over or in respect of the other's Background Intellectual Property.

7.4 If CEH requires the use of the Subcontractor's Background Intellectual Property in order to exercise its rights in Foreground Intellectual Property (whether solely or jointly owned) the Subcontractor will not unreasonably refuse to grant or delay granting a licence to CEH so that CEH may use such Background Intellectual Property for the purpose of exercising its rights in Foreground Intellectual Property.

7.5 The Subcontractor warrants that to the best of its knowledge and belief the performance of the services will not infringe the intellectual property rights of any third party.

8. PUBLICATION

8.1 The personnel engaged in the performance of the Project are entitled to make publications of the results in accordance with normal academic practice, subject to clauses 8.2, 8.3 and 10, and Clauses 41 to 46 of the Main Contract.

8.2 The Subcontractor will submit results intended for publication to the Project Manager in writing not less than 60 days in advance of the publication. [This period will allow the Project Manager to seek necessary approval for publication from UNEP according to Clauses 41 to 46 of the Main Contract].

8.3 CEH will endeavour to facilitate permission for publication from UNEP and agrees not to unreasonably prevent such publication.

9. QUALITY ASSURANCE

9.1 The Subcontractor shall and shall procure that persons associated with it or other persons who are performing services or providing goods in connection with this agreement shall comply with all applicable laws, statutes and regulations relating to bribery and corruption, including but not limited to the Bribery Act 2010.

9.2 The Subcontractor shall (and shall ensure that all of their staff) comply with any notification requirements under the Data Protection Act 1998 ("DPA") and all Parties will duly observe all their obligations under the DPA which arise in connection with the agreement, whether as a data processor or a data controller (as relevant and defined under the DPA). Each Party shall where relevant comply at all times with the eight principles which are set out in Schedule 1 of the DPA.

9.3 The Subcontractor shall (and shall ensure that all of their Staff) comply with all requirements under the Joint Code of Practice for Research (JCoPR) and all Parties will duly observe all their obligations under JCoPR which arise in connection with the agreement. The Joint Code of Practice for Research guidelines can be accessed using the following hyperlink: https://www.gov.uk/government/publications/joint-code-of-practice-for-research-jcopr

10. CONFIDENTIALITY

10.1 CEH and the Subcontractor each agree to hold all Confidential Information received from the other Party in confidence and neither Party will disclose to any third party, nor use for any purpose except as expressly permitted by this contract, any of the other Party's Confidential Information.

10.2 Neither Party will be in breach of clause 10.1 to the extent that the Confidential Information;
(i) is known to the Party making the disclosure before its receipt from the other Party, and not already subject to any obligation of confidentiality to the other Party;
(ii) is or becomes publicly known without any breach of this contract or any other undertaking to keep it confidential;
(iii) has been obtained by the Party making the disclosure from a third party in circumstances where the Party making the disclosure has no reason to believe that there has been a breach of an obligation of confidentiality owed to the other Party;
(iv) has been independently developed by the Party making the disclosure;
(v) is disclosed pursuant to the requirement of any law or regulation or the order of any court of competent jurisdiction; or
(vi) is approved for release in writing by an authorised representative of the other Party.

11. FREEDOM OF INFORMATION

CEH is subject to the Freedom of Information Act 2000 and regulations made under it, which require CEH to make certain information (which may include Confidential Information) available to members of the public on request. Wherever possible, and in accordance with any applicable code of practice issued with the legislation, CEH will consult with the Subcontractor before making any disclosure of Confidential Information pursuant to the legislation.

12. LIABILITY

12.1 The Subcontractor undertakes to observe the terms and conditions of the main contract so far as they relate to the Scope of Work and agrees to indemnify CEH from and against all costs, claims, damages and actions resulting from any breach on the part of the Subcontractor to observe or perform its obligation pursuant to the agreement or the terms and conditions of the main contract.

12.2 The aggregate liability of the Subcontractor in respect of or attributable to any breach, non-observance or non-performance of this agreement, any error or omission or by negligence and whether in contract, tort or otherwise or arising in any other way out of the subject matter of this agreement, Scope of Work or the results including any indemnity offered by the Subcontractor to CEH under this agreement, shall be limited to US dollars 12,000,000 in aggregate for any claim or series of claims, except in the case of negligence leading to death or personal injury where no limit will apply.

12.3 For the avoidance of doubt, the Subcontractor shall not be liable to CEH for indirect loss or damage, including without limitation loss of turnover, profits, business, revenue, goodwill, opportunity or anticipated savings no matter how arising, whether by breach or by negligence and whether in contract, tort or otherwise.

12.4 The Parties agree that the terms and conditions in this agreement are in place of any warranties, undertakings, obligations or conditions implied by common law, statute, trade usage, custom or otherwise as to the merchantable quality or the fitness for any particular purpose of the goods and services being supplied under this agreement.

13. INSURANCE

13.1 The Subcontractor shall take out professional indemnity and public and products liability insurance policies to cover its liabilities under this agreement.

13.2 Where the Subcontractor is using a CEH vehicle the Subcontractor will arrange their own personal injury cover.

14. FORCE MAJEURE

14.1 If the performance by either Party of any of its obligations under this agreement (except a payment obligation) is delayed or prevented by circumstances beyond its reasonable control, that Party will not be in breach of this contract because of that delay in performance. However, if the delay in performance is more than three (3) months, the other Party may terminate this contract with immediate effect by giving written notice.

14.2 Upon termination due to a force majeure event, all sums owing and results from the Project pursuant to this agreement shall become due. All parties shall use their reasonable endeavours to minimise the effects of any force majeure.

15. NOTICES

15.1 Except as otherwise expressly provided within the agreement, no notice or other communication from one Party to the others shall have any validity under the Contract unless made in writing by or on behalf of the Party concerned.

15.2 The nominated officers who will provide for the necessary liaison between CEH and the Subcontractor on all aspects of the programme shall be:

Party	**Scientific**	**Legal**	**Financial**
CEH	PROJECT MANAGER	CEH Research Contracts Team	NERC RCUK Shared Services

	Centre for Ecology and Hydrology SITE ADDRESS EMAIL	Centre for Ecology and Hydrology Maclean Building Benson Lane Crowmarsh Gifford Wallingford Oxfordshire OX10 8BB cehresearchcontracts@ceh.ac.uk	Centre Ltd Polaris House North Star Avenue Swindon SN2 1EU Tel: 01793 867004 E-mail: finance@ssc.rcuk.ac.uk
SUBCONTRACTOR			

16. ASSIGNMENT

Neither Party may assign or transfer this agreement as a whole, or any of its rights or obligations under it, without first obtaining the written consent of the other Party. That consent may not be unreasonably withheld or delayed.

17. JURISDICTION

This agreement shall be governed by the laws of England and Wales and the Courts of England and Wales shall have exclusive jurisdiction to deal with any dispute which may arise out of or in connection with this agreement.

18. COUNTERPARTS

This agreement may be executed in any number of counterparts, each of which when executed (and delivered) will constitute an original of this agreement, but all counterparts will together constitute the same agreement. No counterpart will be effective until each Party has executed at least one counterpart.

19. ENTIRE AGREEMENT

19.1 This agreement and its Schedules constitutes the entire agreement of the Parties relating to the subject matter addressed in this agreement. This agreement supersedes all prior communications, contracts, or agreements between the parties with respect to the subject matter addressed in this agreement, whether oral or written.

19.2 This agreement may only be amended with the written consent of both Parties.

Each Party hereby confirms its agreement to the terms contained in this agreement.

Signed on behalf of CEH:

Print Name:

Job Title:

Date:

Signed on behalf of the Subcontractor:

Print Name:

Job Title:

Date:

Schedule 1: Scope of Work

Schedule 2: Main Contract

3 Terms of Reference (TOR) for Project Level Decision Making and Planning Bodies

3.1 Background

The overall project governance and internal communication flows within the 'Towards INMS' project are summarized in Figure A11.1. General oversight of project activities will be undertaken by the **Project Management Board (PMB)**, which will allow project-level communication between the **Component Leaders**, the **Project Co-ordination Unit (PCU)**, the **Executing Agency (EA)** (i.e. NERC-CEH on behalf of INI) and the **Implementing Agency (IA)** (i.e. UNEP). The PCU will undertake the day-to-day functions of the project, including maintaining communication between all parties in the project. Each of these groups is outlined below and further details can be found in Appendix 10.

The work of the project will be reviewed and informed by the **Project Partners Assembly (PPA)**, which consists of representatives of all main partners (i.e. funding partners). It represents the overarching decision-making body. In addition, the project includes a **Stakeholder and Policy Advisory Group (SPAG)** to provide advice to the project and support wider dissemination. Members of the SPAG may also be **Main Partners** of the project, in which case they will also be members of the PPA. Members of the SPAG otherwise have **observer** status at the PPA. External communication from the project is further supported by Component 4, which includes focus on public engagement and awareness raising. In addition to the partnership itself, the PCU and Partners may also utilize **Consultants** to conduct specific aspects of the work. Such consultants have observer status at the PPA, being represented in decisions of the PPA by their relevant hosting Main Partner.

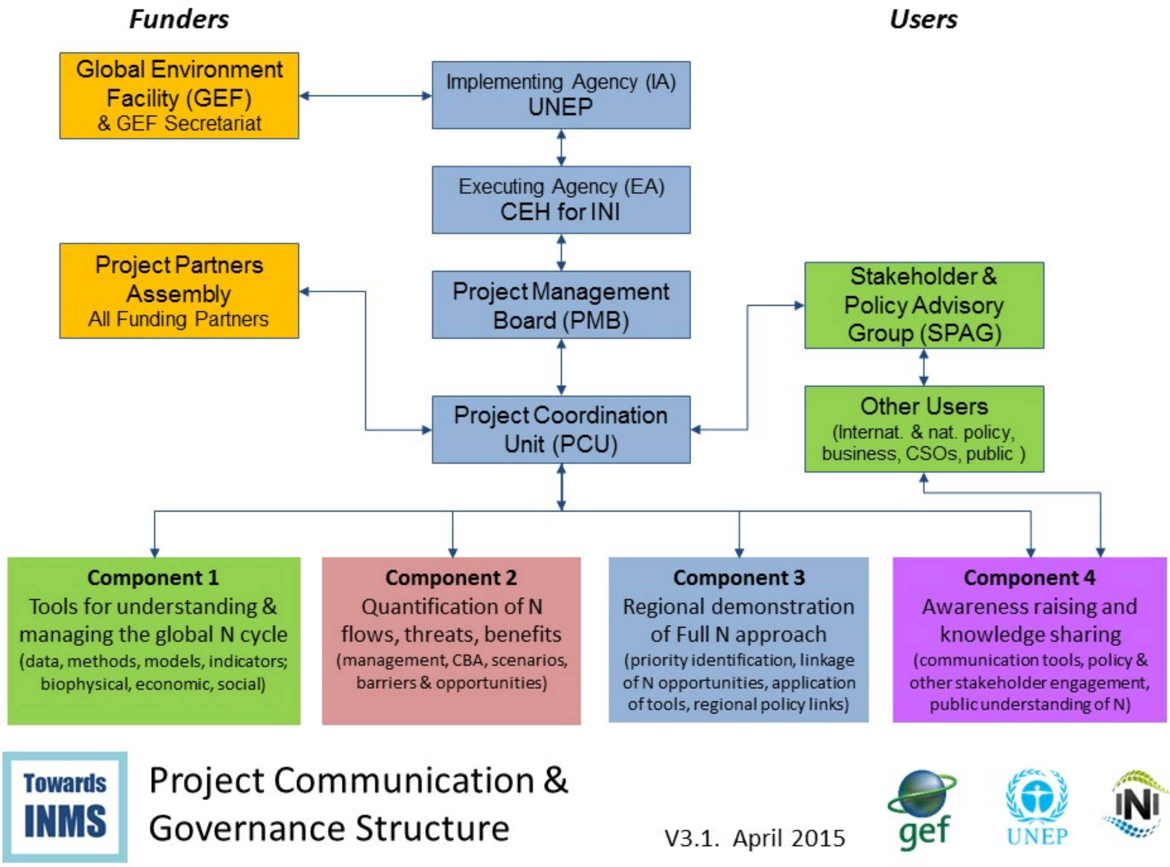

Figure A11.1: *Summary of the Towards INMS project communication and governance structure. Catalytic funding is provided by the Global Environment Facility, while all funding partners are represented in the Project Partners Assembly. UNEP is the Implementing Agency (IA), while the International Nitrogen Initiative (INI) is the Executing Agency (EA), as hosted by CEH. The Project Coordination Unit (PCU) is the team that actually manages the project coordination (based at the EA), who work closely with the Project Management Board (Component Leaders, IA and EA). The project is supported by the Stakeholder and Policy Advisory Group (SPAG), which consists of key users, which may also be project partners. Membership of the SPAG will be proposed during project Inception Phase by the EA and IA, for agreement by the Project Partners Assembly.*

3.2 Project Co-ordination Unit (PCU)

3.2.1 Overview of PCU Staff, Roles and Funding

Project Co-ordination Unit (PCU) The Project Co-ordination Unit (PCU) will be responsible for day-to-day project management and execution and will work closely with the project partners to ensure the objectives of this project are achieved. They will be responsible for providing the PPA, PMB, IA, EA and the GEF with all management information and the required outputs from the project. The PCU will be responsible for the organisation of the Inception Meeting and subsequent meetings of the Project Partners Assembly, and provide secretariat facilities for PMB, PPA and SPAG.

Staff of the PCU The PCU will consist of a Project Director (25% Full Time Equivalent, FTE), Project Co-ordinator (100% FTE), Technical support specialist (50% FTE), Project Management and Communications support will also be provided (up to 100% FTE, depending on staffing needs and availability), Financial support staff (25% on project, fully funded by CEH funds) and will be assisted by external consultants as required

The PCU shall be responsible for:

- Day-to-day administration and management of the project
- Provide all internal communication functions, e.g. to Component Leaders, PPA, SPAG through mailing lists and newsletters etc
- Collect and collate information on outputs from Task, Activity and Component Leaders
- Provide progress reports for PMB, PPA, SPAG
- Provide secretariat function for PMB, PPA, SPAG
- Provide necessary quarterly and annual reports for UNEP & GEF
- Maintain dialogue with UNEP Task Manager on progress and any arising issues

3.2.2 Terms of Reference for the Staff of the PCU

Project Director

The Project Director will lead and oversee the day-to-day implementation of the workplan and budget of the project, facilitated by the Project Co-ordinator, based on the UNEP Project Document, including all Appendices. The Project Director will head the PCU, including a multidisciplinary team of professionals and consultants working for the project. The Project Director is responsible for the implementation of the workplan in respect of the allocated budget and timetable by the following:

- Day to day technical inputs into various project planning and implementation processes;
- Coordinating and overseeing the work of the bodies created under the *Towards INMS* Project, as facilitated by the Project Co-ordinator;
- Overseeing the day to day work of the PCU through a team consisting of professional, technical and administrative staff
- Overseeing and directing the reporting activities to the Implementing Agency (UNEP), the Executing Agency (CEH), the GEF and to the Project Management Board (PMB) and ensuring adherence to the Implementing Agencies' administrative, financial and technical reporting requirements;
- Overseeing the development of information management tools to ensure evaluation, monitoring and replication activities;
- Overseeing and directing the organization and execution of training and communication activities including workshops, training sessions, conferences and other meetings required by the workplan;
- Liaising, consulting with and networking with appropriate and relevant national and regional partner agencies and intergovernmental bodies;
- Promoting actively the *Towards INMS* Project and UNEP principles in all relevant media and fora.

Following UN rules, he/she approves administrative and financial reports, external communications, consultancy contracts and travel requests, as well as the acquisition of equipment. Specifically the Project Director:

- Develops the agenda for the PMB meetings, prepares all technical background documentation in consultation with others partners; oversees the secretariat functions of the PMB, which are provided by the Project Co-ordinator;
- Oversees the co-ordination of the communications to and from the different bodies created under the Towards INMS Project and directs the organization of meetings, including for the Project Management Board and Project Partners Assembly;

- In consultation with the Executing Agencies, the Project Director oversees the hiring of staff (professionals, technical, admin and support) and is responsible for the process of selecting experts and consultants.

Qualifications:

- Post Graduate Degree in environmental management, environmental sciences, natural resources management, or related field;
- At least 10 years' experience working on reactive nitrogen issues at national and international levels;
- At least 10 years' experience working as a principal investigator on internationally funded environmental projects
- At least 10 years' experience of working at an inter-governmental level and presenting technical arguments to policy fora;
- Demonstrated understanding of sustainable development, including financial and institutional sustainability;
- Experience in promoting sustainability and environmental awareness to diverse audiences including opinion and decision makers; track record in implementing change;
- Experience in project co-ordination and in implementing UN or GEF funded projects an asset; and
- Full written and oral command of English; knowledge of other languages an asset.

Project Co-ordinator

The Project Co-ordinator will assist the Project Director in the oversight and quality control of all technical activities undertaken or contracted by the PCU and serve as a central focal point for the *Towards INMS* Project on technical and co-ordination information. The Project Co-ordinator will report to the Project Director. Specifically the Project Co-ordinator will be responsible for:

- Co-ordinating the work of the bodies created under the *Towards INMS* Project, as directed by the Project Director;
- Supervising the technical and management activities of the project and ensuring the quality of the outputs and internal reporting;
- Drafting technical Terms of Reference for endorsement by the Project Director for all project activities;
- Directly supervising the day to day work of the PCU through a team consisting of professional, technical and administrative staff;
- Assist the Project Director and the Executing Agency in the selection of Consultants for undertaking the proposed work;
- Providing summary reports on progress of technical activities to the Project Director and, when requested, to the Project Management Board and other project oversight bodies; and
- Providing the secretariat functions for the Project Management Board, Stakeholder Policy Advisory Board and Project Partners Assembly
- Co-ordinating the reporting activities to the Implementing Agency (UNEP), the Executing Agency (CEH), the GEF and to the Project Management Board (PMB) and ensuring adherence to the Implementing Agencies' administrative, financial and technical reporting requirements;

- Co-ordinating the development of information management tools to ensure evaluation, monitoring and replication activities, as informed by the Project Director;
- Co-ordinating the organization and execution of training and communication activities including workshops, training sessions, conferences and other meetings required by the workplan and as directed by the Project Director;
- Liaising, consulting with and networking with appropriate and relevant national and regional partner agencies and intergovernmental bodies;
- Promoting actively the *Towards INMS* Project and UNEP principles in all relevant media and fora.
- Presenting the work activities and results to stakeholders and other interested parties, including at international conferences.

Qualifications:

- A post graduate qualification in environmental management/science with a particular focus on biogeochemical cycling;
- At least 5 years work experience, ideally in an international setting, on projects with a focus on reactive nitrogen, including links to international policy
- Excellent communications skills;
- Good computer skills (Word, Excel, Powerpoint, etc.); and
- Full written and oral command of English; knowledge of other languages an asset.

Technical Support Specialist

- Supporting the Project Co-ordinator in co-ordinating the work of the bodies created under the *Towards INMS* Project;
- Providing summary reports on progress of selected technical activities to the Project Co-ordinator;
- Presenting the work activities and results to stakeholders and other interested parties, including at international conferences.

Qualifications:

- A post graduate qualification in environmental management/science with a particular focus on biogeochemical cycling;
- Work experience, ideally in an international setting, on projects with a focus on biogeochemical cycling, including links to international policy
- Excellent communications skills;
- Good computer skills (Word, Excel, Powerpoint, etc.); and
- Full written and oral command of English; knowledge of other languages an asset.

Project Management and Communication Support

The Project Management and Communication Support will provide vital assistance for the 'Towards INMS' communications hub, with the post-holder taking an active role in the development and maintenance of the website and social media interfaces during the project, but also supporting the

Project Director, Project Co-ordinator and Technical Support Specialist in the daily management of the project, including internal communications.

The Project Management and Communication Support Officer will:

- Develop and deliver the 'Towards INMS' communications hub. This will involve taking an active role in the development of the website and newsletters, producing and updating content and assisting in the development of the social media communications strategy;
- Develop and maintain contact databases, assisting in the development of effective project communication systems;
- Handle day-to-day enquiries/communications of the project office and engage in networking activities. This will include being effective in assigning enquiries to other team members as necessary;
- Aid in the organization and running of project/network related meetings, including taking an active role in developing systems to manage both registration and travel funding application mechanisms;
- Maintaining project records, such as taking minutes, noting decisions etc and preparing these for review;
- Editing of project reports and dissemination materials;
- Aid in the development of relevant visual materials for the project and network.

Qualifications:

- A good degree in an appropriate subject (such as science/environmental science, however a degree in communications or information technology, with a demonstrated interest in environmental subject matter would also be acceptable);
- 3 years postgraduate training or work experience in communications, project management or environmental science would be desirable;
- Excellent communications skills;
- Good computer skills (word, Excel, Powerpoint etc.); experience of managing websites and use of social media to raise awareness, would be an advantage;
- English capability both written and spoken.

Project Financial Controller

The Project Financial Controller will be responsible for the financial administration of all aspects of the INMS project, including financial reporting, managing payments to project partners according to the progress of the work and the day to day aspects of the project management involving finances and contractual issues.

The Project Controller will work with the Project Director and Project Co-ordinator. Specifically, the Project Financial Controller will:

- Maintain financial records according to CEH and UNEP standards;
- Set up subcontracts with project partners
- Provide all necessary financial reports;
- Monitor budgets and expenditures on the project at NERC-CEH level but also at the project level;

- Assist the Project Director and Project Co-ordinator with overall budget management and to ensure that appropriate planning is undertaken to provide all interested organizations with cash-flow predictions;
- Assist with establishing and quantifying all pledged co-funding in support of the project;
- Assist with all internal audits;
- Processing payments associated with the project.

Qualifications:

- Appropriate financial / accounting qualification;
- At least 6 years work experience post qualifications;
- Experience of UNEP, GEF or other internationally funded project accounts;
- Excellent computer skills (Word, Excel, Powerpoint etc.); and
- Full written and oral command of English.

3.3 Terms of Reference (TOR) for Project Management Board (PMB)

Establishment of the PMB

A Project Management Board will be formed at the start of the project by INI/CEH as the Executing Agency, with membership and ToR to be endorsed by the Project Partners Assembly at the Inception meeting.

Project Management Board Membership

Membership of the PMB shall consist of representatives of core parts of the work plan – in this case, Component Leaders. Both the Implementing Agency UNEP and Executing Agency (NERC-CEH on behalf of INI) shall also be represented.

The PMB may agree, by consensus, at the commencement of each meeting to co-opt additional experts as observers or advisors to any meeting or meetings of the Board or part thereof, as the PMB shall deem appropriate.

The Project Management Board shall be Chaired by the Project Director. The EA and IA may also propose a Vice-Chairperson in the case of absence of the Project Director, for agreement by the PMB. The role of Chairperson will be reviewed during the annual face-to-face meetings of the PMB which will be held alongside the meeting of the Project Partners Assembly.

Secretariat of the Project Management Board

The Project Co-ordinating Unit (PCU) established by NERC-CEH under authority of the project document shall act as Secretariat for the Committee.

Meetings of the Project Management Board
The PCU acting in its capacity as the *Towards INMS* Project Secretariat, shall convene annual meetings of the Project Membership Board and any further meetings as required for the execution of the project (including use of electronic conferencing facilities). Additional meetings may be convened under the instruction of either the IA, EA, Project Director or if a request is made by a majority of PMB members.

Terms of Reference

The Project Membership Board shall operate on the basis of consensus to:

- Provide direction, and strategic guidance to the Project Coordination Unit regarding project implementation and execution of agreed activities over the entire period of the project including the establishment of timelines and milestones for provision of agreed outputs;
- Review and approve the annual work programme and budget for project execution ensuring that these remain focused on the project overall goal and objective;
- Facilitate co-operation and co-ordination among the participating institutions, organisations and agencies particularly in possible trans-national environmental issues and cross component issues;

- Review and evaluate progress in project implementation and execution, and provide guidance to the PCU and core partners regarding areas for improvement, paying particular attention to:
    - progress in implementation of the various project components;
    - the monitoring and evaluation plan of the project;
    - the quality of outputs produced;
    - the sustainability of the project outcomes; and
    - the replicability of actions recommended by the project;
- Assist UNEP and the PCU in soliciting wide support for the project and raising such additional co-financing as may be required from time to time;
- In order to enhance dissemination of project results and recommendations, the PMB shall review and monitor:
    - stakeholder buy-in to the project during implementation (by review of the Monitoring and Evaluation survey reports);
    - whether results reach intended targets; and
    - the risks of failure;
- Approve annual Project Implementation Review reports, for transmission to UNEP's financial and management services and to the GEF Secretariat;
- Consider and approve such recommendations as shall be presented to the PMB by the Project Co-ordination Unit, the Project Partners Assembly and the SPAG regarding project execution;
- Review and approve the outline of, and subsequently the final reports arising from the project, including conclusions and recommendations particularly focusing on quality of outputs, and the information dissemination strategy, including its utility by potential users; and
- Agree at their first meeting:

    a) the membership, meeting arrangements and terms of reference of the PMB as prepared in draft in this document; and

    b) rules of procedure, and such standing orders and manner of conducting business as may be considered necessary by the committee.

Conduct of PMB Business

The PMB shall operate and take decisions on the basis of consensus, regarding any matter relating to project execution that has implications for core partners. Where full consensus cannot be achieved in reaching agreement during a full meeting of the PMB, on any matter relating to project execution that has implications for core partners, the Secretariat shall, in consultation with the Chairperson, facilitate negotiations during the subsequent inter-sessional period with a view to seeking resolution, and will report the results of these negotiations to the PMB members.

Other Matters

Notwithstanding the membership and terms of reference contained in this document the Project Management Board shall have the power to amend, from time to time, the membership and its terms of reference, subject to agreement with the EA & IA.

Rules of Procedure for the Project Management Board for the UNEP/GEF *Towards INMS* Project:

The following provisional rules of procedure are drafted as a basis for adoption or amendment during the first meeting of the PMB.

MEMBERSHIP

Rule 1 – Full members

Full members of the PMB shall consist solely of component leaders, plus a designated representative of the Implementing Agency (UNEP) and the Executing Agency (NERC-CEH on behalf of INI).

Rule 2 – Representation at meetings

Where possible, where there are two component leaders, both should be present at PMB meeting. In cases where neither component leader will be able to attend the meeting, it is the responsibility of the co-component leaders to find a suitable representative (see Rule 3) and ensure they are informed of progress in the relevant component, in advance of the meeting.

Rule 3 - Alternate members

In the event that there a component is not represented by a component lead, the co-component leads must agree and secure a suitable alternative representative and communicate this choice to the PCU, 4 weeks ahead of the meeting. Alternate members in this case will have the same rights as the component leaders they represent.

Rule 4 - Amendment of the membership

Notwithstanding the rules contained in this document, the Project Management Board shall have the power to amend, from time to time, its membership, subject to agreement of the EA and IA.

Rule 5 - Co-opted members and observers

The PMB may agree, by consensus at the commencement of each meeting to co-opt to any meeting or meetings of the Committee or parts thereof, as the Committee shall deem appropriate:

1. additional experts as observers or advisers; and
2. alternate representatives who have not been designated under rule 3 as full members.

SESSIONS

Rule 6 - Regular sessions

The Project Co-ordinating Unit shall convene regular annual meetings of the Project Management Board (usually alongside an annual or other meeting of the project).

Rule 7 - *Ad hoc* meetings

Ad hoc *meetings may be convened by the IA/EA:*

1. when the majority of members make a request for such a meeting to the Project Co-ordinating Unit; and
2. at the request of the Project Co-ordinating Unit when circumstances demand.

Rule 8 - Drawing up of the provisional agenda

The Project Director and Project Co-coordinator shall liaise with the Project Management Board Members (including electronically) and Project Co-ordination Unit to collate and agree on a provisional agenda. Items proposed by members shall be accompanied by supporting information and/or background documentation where possible, one month before a meeting. This information will be referenced in the provisional agenda.

Rule 9 - Distribution of the agenda

The Project Co-ordinating Unit shall communicate the provisional agenda of each Project Membership Board meeting together with all background documentation, to the members 4 weeks in advance where possible.

Rule 10 - Adoption of the Agenda

At the commencement of each PMB meeting, the PMB shall adopt the agenda for the meeting on the basis of the provisional agenda.

Rule 11 - Revision of the agenda

At the start of each PMB meeting the provisional agenda will be reviewed by the members for agreement. At this point if urgent and important matters have arisen since the drafting of the provisional agenda, these can be added to the agreed agenda for the meeting.

Rule 12 - Acting Chairperson

If the Chairperson cannot preside at a meeting or any part thereof, Vice-Chairperson shall be appointed by the EA and IA to act as Chairperson.

Rule 13 - Powers of the Acting Chairperson

The Vice–Chairperson, acting as Chairperson shall have the same powers and duties as the Chairperson.

Rule 14 - Secretariat

The Project Co-ordinating Unit, under the direction of the Project Director, shall act as Secretariat to the Committee. The secretariat shall:

1. receive and circulate the documents of the PMB;
2. publish and circulate the decisions, reports and relevant documentation of the PMB;
3. have the custody of the documents in the archives of the PCU and generally perform all other work that the PMB may require; and,
4. prepare reports on project progress and future workplans for consideration by the PMB.

Rule 15 - Role of the PCU in the convening and conduct of meetings

The PCU shall:

1. act as Secretary to all meetings of the PMB;
2. designate when appropriate any officer of the Project Co-ordination Unit to act as his/her representative;

3. make oral and written statements to the PMB concerning any question under consideration;
4. be responsible for the necessary arrangements being made for meetings including the preparation and distribution of working documents in accordance with these rules; and,
5. Prepare and deliver reports on project progress and plans to appropriate international meetings of other bodies.

Rule 16 - Quorum

A simple majority of the members of the Committee shall constitute a quorum.

Rule 17 - Powers of the Chairperson

In addition to exercising the powers conferred upon them elsewhere by these rules, the Chairperson shall declare the opening and closing of each meeting of the PMB, shall direct the discussion, ensure the observance of these rules, and shall accord the right to speak, and announce decisions. The Chairperson may also call a speaker to order if their remarks are not relevant to the subject under discussion.

Rule 18 - Conduct of committee business

The Committee shall operate and take decisions on the basis of consensus, regarding any matter relating to project execution that has cross-component significance. Where full consensus cannot be achieved in reaching agreement during a full meeting of the Committee, on any matter relating to project execution that has regional or cross-component significance, the Secretariat shall, in consultation with the Chairperson, facilitate negotiations during the subsequent inter-sessional period with a view to seeking resolution. The Secretariat will report the results of these negotiations to the Committee members.

Rule 19 - Adjournment of debate

During the discussion of any matter on which a clear consensus fails to emerge, a representative may move the adjournment of the debate and its referral to a working group of the committee. The working group shall be charged with resolving the matter and shall be required to report the outcome to the full committee at the time of resumption of the debate. Any such motion shall have priority. In addition to the proposer of the motion, one representative shall be allowed to speak in favour of, and one representative against, the motion.

Rule 20 - Points of order

During the discussion of any matter, a member may raise a point of order. In this case, the Chairperson shall immediately state his/her ruling. If the ruling is challenged, the Chairperson shall forthwith submit their ruling to the Secretariat for decision, and it shall stand unless overruled.

Rule 21 - Closure of debate

A representative may at any time move the closure of the debate whether or not any other representative has signified a wish to speak. Not more than two Members may be granted permission to speak against the closure. The Chairperson shall take the sense of the Secretariat on a motion for closure. If the Secretariat is in favour of the closure, the Chairperson shall declare the debate closed.

Rule 22 - Decisions and amendments

Draft decisions, and substantial amendments or motions, shall be introduced in writing and handed to the Secretary of the Committee, who shall circulate copies to the Members before they are discussed and decided upon, unless the Committee decides otherwise. Upon the request of any member, any motion and amendment thereto made by any speaker shall be given to the Chairperson in writing and shall be read by them before any further speaker is called upon. The Chairperson may direct that any motion or amendment be circulated to the members present. This rule shall not apply to formal motions such as one for closure or adjournment.

Rule 23 - Language of meetings

English shall be the working language of the PMB.

Rule 24 - Records of the meeting

Records of the meetings of the PMB shall be kept by the secretariat. They shall be prepared in the form of a draft report by the Secretary to the Committee working with the Chairperson and presented in draft to the members of the PMB within one week of the closure of the meeting. If the meeting has contained discussion on substantial amendments, debate or points of order, the Secretariat can decide to present the relevant key points of the draft minutes before the closure of the meeting. During consideration of the draft report in committee, members shall inform the Secretary of any changes they wish to have made. Any disagreement concerning such changes that cannot be resolved electronically within 2 weeks of receipt of the draft minutes, shall be referred to the Chairperson, whose decision shall be final. These amended records will be the official minutes of the meeting.

Rule 25 - Distribution of meeting reports

The corrected version of the records of PMB meetings shall be distributed as soon as possible following the agreement of the minutes. This shall include distribution to the GEF Secretariat, the Implementing Agency and the Core Partners and Focal Points in other organisations as considered appropriate by the PCU or as directed by the PMB.

3.4 Terms of Reference (TOR) for Project Partners Assembly (PPA)

Establishment of the PPA

A Project Partners Assembly will be formed at the start of the project by INI/CEH as the Executing Agency, with membership and ToR to be endorsed by the Project Partners Assembly at the Inception meeting.

Project Partners Assembly Membership & Observers

Towards INMS has around 80 Main Partners who contribute funding resources to the project. Membership of the PPA shall consist of one representative from each Main Partner. Both the Implementing Agency UNEP and Executing Agency (NERC-CEH on behalf of INI) shall also be represented. Additional representatives of the Main Partners and other experts and advisors may attend as observers to the Project Partners Assembly.

The EA in consultation with the IA shall propose a Chairperson for the first Project Partners Assembly, which shall take place as a decision making segment of the Project Inception meeting. For subsequent PPA's, to be held during Annual Project Meetings the Chairperson may be agreed in advance by election among the Main Partners.

Secretariat of the Project Partners Assembly

The Project Co-ordinating Unit (PCU) established by NERC-CEH under authority of the project document shall act as Secretariat for the Committee.

Meetings of the Project Partners Assembly

The PCU acting in its capacity as the *Towards INMS* Project Secretariat, shall convene annual meetings of the Project Partners Assembly to be held during Annual Project Meetings and any further meetings as required for the execution of the project (including use of electronic conferencing facilities). Further meetings will be convened under the instruction of either the IA, EA or if a request is made by a majority of PPA members.

Terms of Reference

The PPA will support the execution of the project through the PMB and the PCU, who will report to the PPA annually. Members of the Stakeholder and Policy Advisory Group (SPAG) who are not Partners of INMS and other groups or individuals with an interest in INMS join the PPA as observers. As far as possible the PPA will take decisions by consensus.

The responsibilities of the PPA are to engage in execution of the project through annual meetings, review documents and make recommendations via the PCU to the PMB, more specifically:

- Confirm proposals for membership of the SPAG
- Support the execution of the project through the PMB and the PCU, who will report to the PPA annually;
- Review and approve the annual work programme and budget for project execution ensuring that these remain focused on the project overall goal and objective;
- Review and approve core outputs from the project
- Review and approve M&E outputs/reports

- Facilitate co-operation and co-ordination among the participating institutions, organisations and agencies particularly in possible trans-national environmental issues and cross component issues;
- Approve annual Project Implementation Review reports, for transmission to UNEP's financial and management services and to the GEF Secretariat;
- Review and approve the outline of, and subsequently the final reports arising from the project, including conclusions and recommendations particularly focusing on quality of outputs, and the information dissemination strategy, including its utility by potential users; and
- Agree at their first meeting:

  a) the membership, meeting arrangements and terms of reference of the PPA as prepared in draft in this document; and

  b) rules of procedure, and such standing orders and manner of conducting business as may be considered necessary by the PPA.

Conduct of Project Partners Assembly Business

The PPA shall operate and take decisions on the basis of consensus. Where full consensus cannot be achieved the Secretariat shall, in consultation with the Chairperson, facilitate either negotiations during the subsequent inter-sessional period with a view to seeking resolution or a vote of Full Members of the PPA to achieve a decision.

Other Matters

Notwithstanding the membership and terms of reference contained in this document the Project Partners Assembly shall have the power to amend, from time to time, its membership and terms of reference, subject to confirmation by the EA and IA.

Rules of Procedure for the Project Partners Assembly for the UNEP/GEF *Towards INMS* Project:

The following rules of provisional procedure are drafted as a basis for adoption or amendment during the first meeting of the PPA.

MEMBERSHIP

Rule 1 – Full members

Full members of the PPA shall consist solely of one representative per Main Partner, plus a designated representative of the Implementing Agency (UNEP) and the Executing Agency (NERC-CEH on behalf of INI).

Rule 2 – Representation at meetings

Representatives of each Main Partner should attend the PPA where feasible. Each Main Partner will be asked to designate a representative for their organisation to the PCU, within one month of project start.

Rule 3 - Alternate members

In the event that the designated representative of a Main Partner cannot attend the PPA, it will be the responsibility of the designated representative to explore a potential alternate member for that meeting. In cases where such a person has been found, the PCU should be informed (preferably 4 weeks) prior to the Project Partners Assembly, of the intended alternate. Alternate members in this case will have the same rights as the component leaders they represent. In cases where such a person cannot be found, but the Partner has items which they wish discussed/or specific comments to make, they are requested to provide these comments to the PCU no later than 1 week before the meeting, to allow them to be included within the final agenda.

Rule 4 - Amendment of the membership

Notwithstanding the rules contained in this document the Project Partners Assembly shall have the power to amend, from time to time, its membership.

Rule 5 – Observers

Members of SPAG and additional experts may attend the PPA as observers.

SESSIONS

Rule 6 - Regular sessions

The Project Co-ordinating Unit shall convene regular annual meetings of the Project Partners Assembly (usually alongside an Annual Project Meeting.

Rule 7 - *Ad hoc* meetings

Ad hoc *meetings may be convened by the IA/EA:*

- when the majority of members make a request for such a meeting to the Project Co-ordinating Unit; and
- at the request of the Project Co-ordinating Unit when circumstances demand.

Rule 8 - Drawing up of the provisional agenda

The Project Director and Project Co-coordinator shall liaise with the Project Management Board & the Project Partners Assembly Members (including electronically) and Project Co-ordination Unit to collate and agree on a provisional agenda. Items proposed by members shall be accompanied by supporting information and/or background documentation where possible, one month before a meeting. This information will be referenced in the provisional agenda.

Rule 9 - Distribution of the agenda

The Project Co-ordinating Unit shall communicate the provisional agenda of each Project Partners Assembly meeting together with all background documentation, to the members 4 weeks in advance where possible.

Rule 10 - Adoption of the Agenda

At the commencement of each PPA, the PPA shall adopt the agenda for the meeting on the basis of the provisional agenda.

Rule 11 - Revision of the agenda

At the start of each PPA meeting the provisional agenda will be reviewed by the members for agreement. At this point if urgent and important matters have arisen since the drafting of the provisional agenda, these can be added to the agreed agenda for the meeting.

Rule 12 - Elections of Chairperson

At the first PPA, the Chairperson will be nominated in advance by the EA in consultation with the IA. For subsequent PPA meetings the Chairperson may be agreed in advance by election among the Main Partners.

Rule 13 - Acting Chairperson

If the Chairperson cannot preside at a meeting or any part thereof, a Vice-Chairperson shall act for the Chairperson.

Rule 14 - Powers of the Acting Chairperson

The Vice–Chairperson, acting as Chairperson shall have the same powers and duties as the Chairperson.

Rule 15 - Secretariat

The Project Co-ordinating Unit, under the direction of the Project Director, shall act as Secretariat to the PPA. The secretariat shall:

1. receive and circulate the documents of the PPA;
2. publish and circulate the decisions, reports and relevant documentation of the PPA;
3. have the custody of the documents in the archives of the PCU and generally perform all other work that the PPA may require; and,
4. prepare reports on project progress and future workplans for consideration by the PPA.

Rule 16 - Role of the PCU in the convening and conduct of meetings

The PCU shall provide:

6. the Secretariat to all meetings of the PPA;
7. designate when appropriate any officer of the Project Co-ordination Unit to act as his/her representative;
8. make oral and written statements to the PPA concerning any question under consideration;
9. be responsible for the necessary arrangements being made for meetings including the preparation and distribution of working documents in accordance with these rules; and,
10. Prepare and deliver reports on project progress and plans to appropriate international meetings of other bodies.

Rule 17 - Quorum

A simple majority of the members of the Committee shall constitute a quorum.

Rule 18 - Powers of the Chairperson

In addition to exercising the powers conferred upon them elsewhere by these rules, the Chairperson shall declare the opening and closing of each meeting of the PPA, shall direct the discussion, ensure the observance of these rules, and shall accord the right to speak, and announce decisions. The Chairperson may also call a speaker to order if their remarks are not relevant to the subject under discussion.

Rule 19 - Conduct of PPA business

The PPA shall operate and take decisions on the basis of consensus. Where full consensus cannot be achieved the Secretariat shall, in consultation with the Chairperson, facilitate either negotiations during the subsequent inter-sessional period with a view to seeking resolution or a vote of Full Members of the PPA to achieve a decision.

Rule 20 - Adjournment of debate

During the discussion of any matter on which a clear consensus fails to emerge, a representative may move the adjournment of the debate and its referral to a working group of the PPA. The working group shall be charged with resolving the matter and shall be required to report the outcome to the full PPA at the time of resumption of the debate. Any such motion shall have priority. In addition to the proposer of the motion, one representative shall be allowed to speak in favour of, and one representative against, the motion.

Rule 21 - Points of order

During the discussion of any matter, a member may raise a point of order. In this case, the Chairperson shall immediately state his/her ruling. If the ruling is challenged, the Chairperson shall forthwith submit their ruling to the Secretariat for decision, and it shall stand unless overruled.

Rule 22 - Closure of debate

A representative may at any time move the closure of the debate whether or not any other representative has signified a wish to speak. Not more than two Members may be granted permission to speak against the closure. The Chairperson shall take the sense of the Secretariat on a motion for closure. If the Secretariat is in favour of the closure, the Chairperson shall declare the debate closed.

Rule 23 - Decisions and amendments

Draft decisions, and substantial amendments or motions, shall be introduced in writing and handed to the Secretary of the PPA, who shall circulate copies to the Members before they are discussed and decided upon, unless the Committee decides otherwise. Upon the request of any member, any motion and amendment thereto made by any speaker shall be given to the Chairperson in writing and shall be read by them before any further speaker is called upon. The Chairperson may direct that any motion or amendment be circulated to the members present. This rule shall not apply to formal motions such as one for closure or adjournment.

Rule 24 - Language of meetings

English shall be the working language of the PPA.

Rule 25 - Records of the meeting

Records of the meetings of the PPA shall be kept by the secretariat. They shall be prepared in the form of a draft report by the Secretary to the PPA working with the Chairperson and presented in draft to the members of the PPA within one week of the closure of the meeting. If the meeting has contained discussion on substantial amendments, debate or points of order, the Secretariat can decide to present the relevant key points of the draft minutes before the closure of the meeting. During consideration of the draft report by the PPA, members shall inform the Secretary of any changes they wish to have made. Any disagreement concerning such changes that cannot be resolved electronically within 2 weeks of receipt of the draft minutes, shall be referred to the Chairperson, whose decision shall be final. These amended records will be the official minutes of the meeting.

Rule 26 - Distribution of meeting reports

The corrected version of the records of PPA meetings shall be distributed as soon as possible following the agreement of the minutes. This shall include distribution to the GEF Secretariat, the Implementing Agency and the Core Partners and Focal Points in other organisations as considered appropriate by the PCU or as directed by the PMB & PPA.

4 Terms of Reference for the Stakeholder and Policy Advisory Group (SPAG)

Establishment of the SPAG

A Stakeholder and Policy Advisory Group will be established during the INMS Inception Phase and will meet on an ad hoc basis. A proposal for membership will be made by the PMB for adoption or amendment by the PPA. The group will advise the PMB on scientific, policy and other stakeholder issues as needed to support development of options for an International Nitrogen Management System. The SPAG will be composed of differing expertise as the needs of the project evolve and may include Partners as well as other bodies and individual experts.

SPAG Membership

Membership of the SPAG will consist of, for example, scientific experts, business and industry representatives, civil society and NGO representatives, policy experts including government officials acting in an expert capacity. The SPAG shall elect a Chairperson from its membership, at their first meeting. The role of Chairperson will be reviewed during the annual face-to-face meetings of the SPAG.

Secretariat of the SPAG

The Project Co-ordinating Unit (PCU) established by NERC-CEH under authority of the project document shall act as Secretariat for the SPAG.

Meetings of the SPAG

The PCU acting in its capacity as the *Towards INMS* Project Secretariat, shall convene annual meetings of the SPAG and any further meetings as required for the execution of the project (including use of electronic conferencing facilities and specific topic related meetings). Such further meetings would be convened under the instruction of either the IA, EA, Project Director or if a request is made by a majority of SPAG members.

Terms of Reference

The SPAG will advise the PMB on scientific, policy and other stakeholder issues as needed to support development of options for an International Nitrogen Management System. As far as possible the SPAG will make recommendations to the PMB by consensus.

The responsibilities of the SPAG will include:

- Provide stakeholder advice on the strategy and progress of the project
- Review stakeholder focussed documents to ensure they are relevant and fit for purpose
- Respond to stakeholder consultations
- Provide feedback on project progress, outputs and messages by attending the Project Partners Assemblies and submitting oral/written reports to the PMB
- Meetings will make agreements by consensus and pass advisory recommendations to PMB via the PCU
- Agree at their first meeting:

  a) the membership, meeting arrangements and terms of reference of the SPAG as prepared in draft in this document; and

b) rules of procedure, and such standing orders and manner of conducting business as may be considered necessary by the SPAG.

It will be at the discretion of the SPAG to discuss their rules of procedure prior to their first meeting, however the rules outlined above for adoption for both the PMB and the PPA should be acknowledged as a good starting point.

5 Terms of Reference (TOR) for Component Level & Regional Demonstrations, Decision Making and Planning Bodies

5.1 Overview of roles for Component Level & Regional Demonstrations, Decision Making and Planning Bodies

Project level communication and governance of the work of the Components will be directed by the PMB. Within each Component are a number of Activities (each delivering on one 'Output') and within these, several Tasks (each delivering on a 'Task Output'). To ensure effective delivery of the 'Outputs' and 'Outcomes' of the project, each Component, Activity and Task is guided by a 'Leader' (in most cases two, allowing for flexibility and greater global representation). 'Terms of Reference' for each of these roles is included in the following sections. Component Leaders will be responsible for reporting back to the PCU and PMB on their progress and any issues which need to be addressed, including budget or Work Plan adjustments. Each of the Component Leaders will work with the Activity Leaders and Task Leaders.

To effectively execute the work planned in Component 3, it is necessary that communication flows between each of the regional demonstrations in Activity 3.1 and the remaining activities (A3.2-3.4). Therefore, it is planned to have a 'Component 3 Management Group' (C3MG) which consists of the Component 3 Leaders, Activity leaders and representation from each of the regional demonstrations. Each of the Demonstrations will also form a 'Demonstration Management Group' (DMG), consisting for example of the Regional Co-ordinator(s), Project Officer(s), Task Leaders and additional experts as required.

5.1.1 Overview of roles within Components 1, 2 & 4

Component Leaders At least one (and in most cases two) component leaders will act to supervise and direct the work within a component. They will also be responsible for reporting on implementation and progress relating the Component to the PCU, PMB & PPA.

Activity Leader At least one (and in most cases two) Activity leaders will act to supervise and direct the work within an Activity. They will also be responsible for reporting on implementation and progress relating the Activity to the PCU, PMB & PPA.

Task Leader At least one (and in most cases two) Task leaders will act to supervise and direct the work within a Task. They will also be responsible for reporting on implementation and progress relating the Task to the PCU, PMB & PPA.

5.1.2 Terms of Reference for the Roles within Components 1, 2 & 4

Component Leader

Responsibilities

The Component Leader(s) is responsible for the co-ordination and delivery of outputs within the Component and reporting to PCU, PMB & PPA as required on project outputs, implementation, work plans and budgetary issues. Responsibilities include:

- Day-to-day administration and management of the work undertaken in their Component
- Guide all necessary internal Component communication functions, e.g. to Activity & Task leaders
- Collect and collate information on outputs from Task & Activity Leaders
- Provide progress reports for PMB, PPA, SPAG
- Provide secretariat function for meetings held at Component level
- Provide necessary quarterly and annual reports for UNEP & GEF, through submissions to the PCU
- Maintain dialogue with PCU & PMB on progress and any arising issues

Organisation of relevant meetings

Meetings at Component level will be held at the discretion and need of the Component leaders, or under the request of Activity and Task leaders within the Component. It is anticipated that Component level meetings will form part of the annual project meeting (alongside the PMB and Project Partners Assembly meetings) and Component leaders will need to liaise with the PCU and PMB regarding necessary sessions and invitations.

Qualifications

It is anticipated that most Component leaders will be international experts in their field, with 10+ years postgraduate experience.

Activity Leader

Responsibilities

The Activity Leader(s) is responsible for the co-ordination and delivery of outputs within their Activity and reporting to Component Leaders, PCU, PMB & PPA as required on project outputs, implementation, work plans and budgetary issues. Responsibilities include:

- Day-to-day administration and management of the work undertaken in their Activity
- Guide all necessary internal Activity communication functions, e.g. to Task leaders
- Collect and collate information on outputs from Task Leaders
- Provide progress reports for Component Leaders, PMB, PPA, SPAG
- Provide necessary quarterly and annual reports for UNEP & GEF, through submission to the PCU
- Maintain dialogue with Component Leaders, PCU & PMB on progress and any arising issues

Organisation of relevant meetings

Meetings at Activity level will be held at the discretion and need of the Activity leaders, or under the request of Task leaders within the Activity. It is anticipated that some Activity level meetings will form part of the annual project meeting (alongside the PMB and Project Partners Assembly meetings) and Activity leaders will need to liaise with the PCU and PMB regarding necessary sessions and invitations.

Qualifications

It is anticipated that most Activity leaders will be specialists in their field, with 5+ years postgraduate experience.

Task Leader

Responsibilities

The Task Leader(s) is responsible for the co-ordination and delivery of outputs within the Task and reporting to PCU, PMB & PPA as required on project outputs, implementation, work plans and budgetary issues. Responsibilities include:

- Day-to-day administration and management of the work undertaken in their Task
- Guide all necessary internal Component communication functions, e.g. to persons working on their Task
- Collect and collate information on outputs from colleagues working on the Task
- Provide progress reports for Activity & Component Leaders, PMB, PPA, SPAG
- Keep track of notes and issues discussed at Task level
- Provide necessary quarterly and annual reports for UNEP & GEF, through submissions to the PCU
- Maintain dialogue with Activity & Component Leaders, PCU & PMB on progress and any arising issues

Organisation of relevant meetings

Meetings at Task level will be held at the discretion and need of the Task leaders, or under the request of those working on the Task. It is anticipated that some Task level meetings will form part of the annual project meeting (alongside the PMB and Project Partners Assembly meetings) and Task leaders will need to liaise with the PCU and PMB regarding necessary sessions and invitations.

Qualifications

It is anticipated that most Task leaders will be specialists in their field, with 2+ years postgraduate experience (this will vary greatly due to the variability of the work needs at Task level).

5.1.3 Component 3 Management Group (C3MG)

Establishment of the Component 3 Management Group (C3MG)

A Component 3 Management Group will be formed at the start of the project by INI/CEH as the Executing Agency, with membership and ToR to be endorsed by the Project Partners Assembly at the Inception meeting.

Component 3 Management Group Membership

Membership of the C3MG shall consist of Co-ordinators/directors of each regional demonstration, plus Component 3 and Activity Leaders. The C3MG may agree, by consensus, at the commencement of each meeting to co-opt additional experts as observers or advisors to any meeting or meetings of the Board or part thereof, as the C3MG shall deem appropriate.

The group shall elect a Chairperson from its membership, at their first meeting which is expected to rotate between meetings. The role of Chairperson will be reviewed during the annual face-to-face meetings of the C3MG which will be held alongside the meeting of the Project Partners Assembly.

Secretariat of the Component 3 Management Group

The C3MG Chairperson will be responsible for organising relevant meetings, in communication with the PCU (in relation to annual meetings). They will also be responsible for nominating suitable note takers at each virtual or face-to-face meeting.

Meetings of the Component 3 Management Group

The PCU acting in its capacity as the *Towards INMS* Project Secretariat, shall convene annual meetings of the C3MG and as above, the C3MG Chairperson is responsible for organizing any further meetings as required for the execution of the activities (including use of electronic conferencing facilities).

Terms of Reference

The C3MG will discuss all cross-cutting activities within Component 3 and will advise the Demonstration Management Groups of their recommendations. As far as possible the C3MG will make recommendations to the PMB by consensus.

The responsibilities of the C3MG will include:

- Discuss the strategy and progress of the project and communicate this to the Demonstration Management Groups
- Review Component 3 level documents to ensure they are relevant and fit for purpose
- Provide feedback on project progress, outputs and messages by attending the Project Partners Assemblies and submitting oral/written reports to the PMB
- Meetings will make agreements by consensus and pass advisory recommendations to the Demonstration Management Groups as needed
- Agree at their first meeting:

  a) the membership, meeting arrangements and terms of reference of the C3MG;

  b) rules of procedure, and such standing orders and manner of conducting business as may be considered necessary by the C3MG.

It will be at the discretion of the C3MG to discuss their rules of procedure prior to their first meeting, however the rules outlined above for adoption for both the PMB and the PPA should be acknowledged as a good starting point.

5.1.4 Terms of Reference for Staff in Regional Demonstrations

Demonstration Project Co-ordinators

Demonstration Project Co-ordinators for each demonstration area will be appointed (in some cases two, depending on the nature of the demonstration work needed). They will lead and oversee the day-to-day implementation of the workplan and budget of the demonstration area. They will have the following responsibilities:

- Coordinating and overseeing the work of the demonstration activity, as facilitated by the Demonstration Project Officer(s);
- Overseeing the day to day work of the demonstration activity and Demonstration Project Officer(s);
- Overseeing and directing the reporting activities to the Implementing Agency (UNEP), the Executing Agency (CEH), the GEF and to the Project Management Board (PMB), through the PCU and ensuring adherence to the Implementing Agencies' administrative, financial and technical reporting requirements;
- Overseeing the development of information management tools to ensure evaluation, monitoring and replication activities;
- Overseeing and directing the organization and execution of training and communication activities including workshops, training sessions, conferences and other meetings required by the workplan;
- Liaising, consulting with and networking with appropriate and relevant national and regional partner agencies and intergovernmental bodies;
- Promoting actively the *Towards INMS* Project and UNEP principles in all relevant media and fora.

Specifically they:

- Form part of the Component 3 Management Group;
- Develop the agenda for the Demonstration Management Group meetings, prepares all technical background documentation in consultation with others partners; oversees the secretariat functions of the Demonstration Management Group, which are provided by the Project Officer(s);
- In consultation with the Executing Agencies and the Demonstration Management Group the Demonstration Project Co-ordinator shall oversee the hiring of staff (professionals, technical, admin and support) and shall be responsible for the process of selecting experts and consultants.

Qualifications:

- Post Graduate Degree in environmental management, environmental sciences, natural resources management, or related field;
- At least 7 years' experience working on reactive nitrogen issues in their region;
- Demonstrated understanding of sustainable development, including financial and institutional sustainability;
- Experience in project co-ordination and in implementing UN or GEF funded projects an asset; and
- Full written and oral command of English; knowledge of other languages an asset.

Demonstration Project Officer(s)

The Demonstration Project Officer(s) will assist the Demonstration Project Officers in the oversight and quality control of all technical activities undertaken or contracted by the Demonstration Management Group and serve as a central focal point for the demonstration activity on technical and co-ordination information. The Demonstration Project Officer(s) will report to the Demonstration Project Co-ordinator. Specifically the Demonstration Project Officer(s) will be responsible for:

- Co-ordinating the work of the demonstration activities, as directed by the Demonstration Project Co-ordinator;
- Supervising the technical and management activities of the demonstration activities and ensuring the quality of the outputs and internal reporting;
- Assist the Demonstration Project Co-ordinator and the Demonstration Management Group in the selection of Consultants for undertaking the proposed work;
- Providing summary reports on progress of technical activities to the Demonstration Project Co-ordinator and, when requested, to the Component 3 Management Board, PMB and other project oversight bodies; and
- Providing the secretariat functions for the Demonstration Management Group and Demonstration Stakeholder Advisory Group;
- Co-ordinating the reporting activities to the Implementing Agency (UNEP), the Executing Agency (CEH), the GEF and to the Project Management Board (PMB), through the PCU and ensuring adherence to the Implementing Agencies' administrative, financial and technical reporting requirements;
- Co-ordinating the development of information management tools to ensure evaluation, monitoring and replication activities, as informed by the Demonstration Project Co-ordinator;
- Liaising, consulting with and networking with appropriate and relevant national and regional partner agencies and intergovernmental bodies;
- Promoting actively the *Towards INMS* Project and UNEP principles in all relevant media and fora.
- Presenting the work activities and results to stakeholders and other interested parties, including at international conferences.

Qualifications:

- A post graduate qualification in environmental management;
- At least 3 years postgraduate experience;
- Excellent communications skills;
- Good computer skills (Word, Excel, Powerpoint, etc.); and
- Full written and oral command of English; knowledge of other languages an asset.

5.1.5 Demonstration Management Groups

Establishment of the Demonstration Management Groups

A Demonstration Management Group will be formed for each demonstration activity at the start of the project by the Demonstration Project Manager, with membership and ToR to be endorsed by the and the Component 3 Management Group at the Inception meeting.

Demonstration Management Group Membership

Membership of the each Demonstration Management Group (DMG) shall consist of the Demonstration Project Co-ordinator(s), Demonstration Project Officers and representatives of the Main Partners involved in that demonstration activity. The Demonstration Management Group may agree, by consensus, at the commencement of each meeting to co-opt additional experts as observers or advisors to any meeting or meetings of the Board or part thereof, as the DMG shall deem appropriate.

Each DMG is anticipated to be Chaired by the Reginal Co-ordinator(s) who may also invite leading stakeholders to Chairperson parts of the meetings as appropriate.

Secretariat of the Demonstration Management Group

The Demonstration Project Co-ordinator shall act as Secretariat for the Committee, in collaboration with the Project Officer(s).

Meetings of the Demonstration Management Groups
The Demonstration Project Co-ordinator acting in their capacity as the DMG Project Secretariat, shall meetings of the DMG.

Terms of Reference

The DMG will discuss all activities within the demonstration activity and will advise the C3MG of any their recommendations on cross-cutting activities (i.e. those which are relevant for all partners working on Activity 3.1). As far as possible all decisions and recommendations will be made by consensus.

The responsibilities of the DMG will include:

- Discuss the strategy and progress of the demonstration activity and communicate this to the C3MG
- Review demonstration level documents to ensure they are relevant and fit for purpose
- Provide feedback on project progress, outputs and messages by attending the Project Partners Assemblies and submitting oral/written reports to the PMB & C3MG as appropriate
- Meetings will make agreements by consensus and pass these to the C3MG, PMB, PCU as needed
- Agree at their first meeting:

    a) the membership, meeting arrangements and terms of reference;

    b) rules of procedure, and such standing orders and manner of conducting business as may be considered necessary by the DMG.

It will be at the discretion of the DMG to discuss their rules of procedure prior to their first meeting, however the rules outlined above for adoption for both the PMB and the PPA should be acknowledged as a good starting point.

5.1.6 Demonstration Stakeholder Advisory Groups

Establishment of the Demonstration Stakeholder Advisory Groups

A Demonstration Stakeholder Advisory Group will be established for each demonstration activity during the INMS Inception Phase and will meet on an ad hoc basis. A proposal for membership will be made by the relevant DMG for adoption or amendment by the C3MG. The group will advise the DMG on scientific, policy and other stakeholder issues as needed to support the demonstration activity. The DSAG will be composed of differing expertise as the needs of the project evolve and may include Partners as well as other bodies and individual experts.

DSAG Membership

Membership of the DSAG will consist of for example regional scientific experts, business and industry representatives, civil society and NGO representatives, policy experts including government officials acting in an expert capacity. The DSAG shall elect a Chairperson from its membership, at their first meeting. The role of Chairperson will be reviewed during an annual face-to-face meeting of the DSAG.

Secretariat of the DSAG

The Demonstration Project Co-ordinator(s) with support from the Demonstration Project Officer(s shall act as Secretariat for the Committee.

Meetings of the DSAG
The Demonstration Project Co-ordinator(s), acting as the Secretariat, shall convene annual meetings of the DSAG and any further meetings as required for the execution of the demonstration activities.

Terms of Reference

The DSAG will advise the DMG on scientific, policy and other stakeholder issues as needed to support the demonstration activities. As far as possible the DSAG will make recommendations to the DMG by consensus.

The responsibilities of the DSAG will include:

- Provide stakeholder advice on the strategy and progress of the demonstration activities
- Review stakeholder focussed documents to ensure they are relevant and fit for purpose
- Respond to stakeholder consultations
- Provide feedback on demonstration activity progress, outputs and messages by attending the Project Partners Assemblies and submitting oral/written reports to the DMG, PMB & C3MG
- Meetings will make agreements by consensus and pass advisory recommendations to DMG, C3MG, PMG as needed
- Agree at their first meeting:

    a) the membership, meeting arrangements and terms of reference of the DSAG;

b) rules of procedure, and such standing orders and manner of conducting business as may be considered necessary by the DSAG.

It will be at the discretion of the D to discuss their rules of procedure prior to their first meeting, however the rules outlined above for adoption for both the PMB and the PPA should be acknowledged as a good starting point.

6 Consultants

The project may utilise consultants for technical work, both under the work of the components and within the demonstration activities. An outline of proposed activities to be undertaken by consultants during the project, will be outlined during the inception phase and presented to the Project Management Board and Component 3 Management Board as appropriate. The needs for such work shall then be reviewed and revised on an annual basis, along with the work plan and budgets. Planned consultancy work which is presented for agreement to the Project Management Board and/or Component 3 Management Group should clearly indicate the deliverables expected from the work, timescale for delivery, the total costs and the outputs which this work supports. Consultants contracted to work on Components 1, 2 & 4 will be contracted through the EA, draft terms of reference for which can be found in Section 2 of this document. Consultants working directly on a demonstration activity will most likely be subcontracted through the lead institution working on that project and be subject to their institutional contractual terms and conditions.

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 15

Component 1: Tools & Methods for the N cycle

Contents

1 Component Identification

1.1 Component Summary

The purpose of this component is to develop the necessary tools and approaches that form the basis for improving understanding and quantification of the global nitrogen cycle, and hence create a foundation for developing the necessary interventions at global and regional scales. Component 1 focuses on establishing necessary method, models and indicators, considering especially the datasets that are required. Its perspective crosses from biophysical dimensions, linking water systems (aquatic and marine) to terrestrial systems (including agricultural and other activities) to atmospheric systems, including emissions, transport, levels of nitrogen compounds and deposition. This biophysical perspective is complemented by the development of economic and social perspectives that are critical in understanding the drivers, opportunities and limitations to achieving better nitrogen management at global and regional scales.

The main elements are as follows:

1) Action to develop better indicators of nitrogen systems, including national and farm scale nitrogen budgeting approaches, a suite of nitrogen use efficiency (NUE) approaches, and the relationship between such budget, balance and efficiency indicators to effect based indicators of societal benefits and adverse environmental effects;

2) Development of a threat assessment methodology, including identification of the key threats, stakeholder review and refinement, development of assessment methodology for the different threats and drafting guidance;

3) Development of the methodology for combined assessment of nitrogen fluxes and distribution, considering the linkages between air, land and water, and dispersion through trade, including review of methods for different N components and different environmental compartments, leading to the preparation of guidance methodology;

4) Refinement of approaches for threat benefit valuation, including review of existing studies, refinement of methodology across contrasting economies, integration of the benefits and threats for food, health, ecosystem, climate and energy, and the valuation under future nitrogen scenarios;

5) Development of flux-impact path models for assessment, scenarios and strategy evaluation, including translating storylines into model requirements, review and comparison of component models, designing model framework, application of selected models in a model cluster, and demonstration of the model cluster at global and regional scales;

6) Examination of the barriers to achieving better nitrogen management, linking the economic, social, cultural and other factors that affect adoption of measures, examination of the barriers in food systems and in relation to sustainable consumption, and exploration of the role of a full nitrogen approach and other options to overcome the barriers.

1.2 Links with other Components

This Component provides the inputs necessary for many of the elements in Components 2 and 3. Specifically the work on N system indicators (A1.1) underpins the requirements for subsequent model application, while building consensus on the different output goals in interaction with the regional demonstrations (A3.3). The activities on N threat assessment methodology (A1.2) and N fluxes and distribution methodology (A1.3) provide input to support model evaluation and support the global and regional assessment (A2.3; A3.1), including how data and measurements can underpin regional inventories and model application. The work on cost-benefit analysis delivers the information that is necessary to set management options and future policies in context, especially in relation to future scenarios (A2.4). The development of flux impact path models (A1.5) provides the foundation for subsequent model application at global and regional scales (A2.1) in interaction with the regional demonstrations (A3.1). The examination of barriers to change (A1.6) delivers evidence that complements the model application that informs both Component 3 (A3.1, A3.4) and Component 4, especially in relation to providing support to GEF, IW-LEARN and international policy frameworks (A4.3-A.4.9).

2 Component Design

2.1 Background and context

The central vision of INMS is to develop a scientific basis that can be used to support international policy development across the nitrogen cycle. To date, most efforts have focused on single environmental compartments and issues, such as water, air, climate, ecosystems and soils. For example, the analysis of the GEF Science and Technical Advisory Panel (STAP) highlighted the importance of nitrogen enrichment in the coastal zone,[1] while UNEP has outlined the specific challenges and opportunities to reduce nitrous oxide (N_2O) emissions.[2] Both aspects link to the nitrogen cycle, where a more joined up approach could offer many benefits, including helping to overcome the barriers to change. It is a gradual process to build the level of integration needed, which in particular can deliver the required tools to allow the synergies between management decisions to be addressed. An example is the management of nitrogen in a region that links both to a watershed, contributing to surface water, ground water and marine eutrophication and to an air shed, contributing to air pollution with effects on human health, terrestrial ecosystems and eventually waters, including the marine environment.

A major step forward was made in developing the foundations to join up analysis across the nitrogen cycle through the European Nitrogen Assessment (ENA),[3] which was delivered in support of the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP). For the first time this linked up the multiple benefits and threats of nitrogen at local to regional scales. Parallel progress has been made in the USA by the North American Centre of the INI[4] and the Science Advisory Board of the US-EPA.[5] Similar

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[1] STAP (2011) Hypoxia and Nutrient Reduction in the Coastal Zone: Advice for Prevention, Remediation and Research

[2] UNEP (2013) *Drawing Down N_2O to Protect Climate and the Ozone Layer.* A UNEP Synthesis Report. (Eds.: J. Alcamo, S.A. Leonard, A.R. Ravishankara and M.A. Sutton), United Nations Environment Programme, Nairobi.

[3] Sutton et al. (2011) *European Nitrogen Assessment.* Cambridge University Press.

[4] Suddick E.C. et al. (2013) The role of nitrogen in climate change and the impacts of nitrogen - climate interactions in the United States. *Biogeochemistry* **114**, 1

efforts have pressed forward with these challenges in other regions, including Latin America, East Asia, South Asia and Sub-Saharan Africa.[6,7,8] The main focus, however, has been on assessing the current situation, and such studies have pointed to the need to further develop tools to support integration across the nitrogen cycle. A key step in this direction in providing a global overview has been provided by the Global Partnership on Nutrient Management (GPNM) in partnership with the International Nitrogen Initiative, through the "Our Nutrient World" report prepared for UNEP.[9]

A key element of the necessary tools is the development of nitrogen system indicators, including budgeting approaches at local, national and regional scales, the provision of performance indicators, such as nitrogen use efficiency and nitrogen surplus, and the relationship of these indicators to effect based indicators, such as food production, water and air quality and ecosystem heath.

In order to deliver the required joined up approach, steps forward need to be taken with both community building – bringing different communities together across the nitrogen cycle – and model development. The first of these is focused on two elements which are critical to better management of the nitrogen cycle as a whole, the development of approaches for nitrogen threat assessment and the development of approaches for assessing nitrogen fluxes and distribution. In both cases much is already known on the different parts of the puzzle. The challenge is to bring the science communities together to develop the joined up picture that links water, air, land etc. This work will build on the context of outcomes developed through UNEP, GEF, UNECE, UNEP, OECD, CBD, UNFCCC, FAO and others as described in the next section.

The development of modelling tools in 'Towards INMS' is a key element in the project. Work has already started on this through the support of the UK NERC funded project "INMS Pump Priming" with a workshop held during 2015. The challenge is to bring together models that describe different parts of the nitrogen cycle at global and regional scales. This must be done in such a way to allow data compatibility and information flow between models requiring efforts in communication, harmonization and building of new model chains, including their demonstration.

Work on Cost Benefit Analysis (CBA) will build on several studies that have already started in the US, Europe and China.[10,11,12,13] In particular, this will need to go through the next steps to build consensus of approaches as well as means of regionally applying the methods, including substantial methodological challenges and the requirement for consensus building (e.g. valuing of human life and health impairment (e.g. Disability Adjusted Life Years, DALY), valuing of ecosystems etc). This work will link with other ongoing international activities such as TEEB, ECLAIRE, TFRN, PRO-BAPS, WHO etc) to ensure that the development and application for nitrogen is consistent with other developing ideas internationally.

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[5] EPA-SAB (2011) Reactive Nitrogen in the United States: An Analysis of Inputs, Flows, Consequences, and Management Options - A Report of the Science Advisory Board. (EPA-SAB-11-013).

[6] Austin et al. 2013, Science, **340**, 149. *Latin America's nitrogen challenge.*

[7] Abrol Y.P., Raghuram N. & Chanakya H.N. (Eds.) (2008) Reactive Nitrogen in Indian Agriculture, Environment and Health. *Current Science* (Nitrogen Special Issue) **94**, 1375-1477.

[8] Kampala Statement-for-Action on Nitrogen in Africa and Globally (2013) www.initrogen.org

[9] Sutton M.A. et al. (2013) Our Nutrient World: The challenge to produce more food and energy with less pollution. Global Overview of Nutrient Management. Edinburgh: CEH for UNEP, on behalf of the GPNM and INI.

[10] Van Grinsven H.J.M. et al. (2013) Costs and benefits of nitrogen for Europe and implications for mitigation. *Environ. Sci.Technol*., **47**, 3571-3579.

[11] Birch M.B.L. et al. (2011) Why metrics matter: Evaluating policy choices for reactive nitrogen in the Chesapeake Bay watershed. *Environ. Sci.Technol*., **45**, 168−174.

[12] Gu B. et al. (2012) Atmospheric reactive nitrogen in China: Sources, recent trends, and damage costs. *Environ. Sci. Technol.* **46**, 9420–9427

[13] Ahtiainen, H., Artell, J., Czajkowski, M., Hasler, B., Hasselström, L., Huhtala, A., Meyerhoff, J., Smart, J.C., Söderqvist, T., Alemu, M.H. and Angeli, D. (2014) Benefits of meeting nutrient reduction targets for the Baltic Sea–a contingent valuation study in the nine coastal states. *J. Environmental Economics and Policy* **3**, 278-305.

The work on addressing the barriers to better nitrogen management is a new area, which has so far received little attention in the networks mentioned here (and further below). This activity will therefore seek to learn from other domains to apply lessons to the context of nitrogen management. Specifically the question will be asked: to what extent can a joined up approach to nitrogen management, offering multiple co-benefits to economy, health, ecosystems, climate etc help overcome the barriers to change.

Work in Component 1 will utilise this background to focus on the following key areas:

- Development, agreement and application of key indicators of the nitrogen cycle, including full-chain and component nitrogen use efficiency and nitrogen balances, with appropriate benchmarking that will assist the management and reporting of regions suffering from excess and insufficient reactive nitrogen. These indicators will be adapted for specific stakeholder use, for example indicators of relevance to the private sector (including both producers and users of N_r) that will enable effective nitrogen use to be assessed and reported that could also provide economic guidance on the use of N_r;
- Development and agreement of cost-benefit assessment techniques that will be applicable at the national and local levels to better assist governments identify and agree mitigation methods and can be combined with an analysis of the barriers to better nitrogen management.
- Development of tools (including source-receptor, dose-response and integrated assessment models) to enable countries to better understand the nitrogen cycle at the local, regional and global levels, enabling estimates of surplus and impacts of reactive nitrogen at different scales for air, land, water;

Key outputs of Component 1 are:

Output 1.1. Indicators for assessing full N budgets, use, levels and impacts, including N use efficiency and benchmarking. Indicators would be designed and tested for relevance to specific stakeholders

Output 1.2. Methodology for nitrogen threat assessment

Output 1.3. Methods for determining N fluxes and distribution (water, air, land, agriculture, industry etc)

Output 1.4. Approaches to estimate the value of N threats and benefits

Output 1.5. Approach to using existing N flux/pathway models and harmonizing their results for global/regional assessments and scenario analysis

Output 1.6. Understanding the barriers to change at all levels of society (government, private sector and civil society) including technical, financial and socio-political limitations.

2.2 Baseline

2.2.1 Baseline analysis

Nitrogen System Indicators

This work builds on activities by several bodies, including the OECD, UNECE, INI, GPNM and the EU Nitrogen Expert Panel.

Substantial work has been accomplished at the Organisation for Economic Cooperation and Development (OECD) in developing its soil nitrogen balance (work ongoing since the 1990s). This is an agri-environment indicator operated at a national scale that considers part of the agricultural system from the view of agricultural soils. Performance indicators deriving from this approach include the soil nitrogen balance, including the extent of soil nitrogen surplus or deficit as well as nitrogen use efficiency (NUE) from the perspective of agricultural soils.

Subsequently, work in the UNECE Task Force on Reactive Nitrogen (TFRN), which is a body under the LRTAP Convention, has sought to develop national nitrogen budgets considering all sources and a whole-territory approach. The development of national nitrogen budgets has been taken forward by the TFRN's Expert Panel on Nitrogen Budgets (EPNB). A key step forward was made in the establishment of TFRN itself under the LRTAP convention (LRTAP Executive Body Decision 2007/1) in that a mandate was given not just to look at nitrogen air pollution, but to develop the science and policy options that can be useful for other policy purposes across the nitrogen cycle. This allowed the TFRN to establish the EPNB, which delivered several national nitrogen budgets for the European Nitrogen Assessment (ENA) including European Nitrogen Budgets for 1900 and 2000,[14] prepared as an activity of INI. The EPNB has since worked to standardise the methodologies for establishing nitrogen budgets for all sources, including establishment of an outline Guidance Document on National Nitrogen Budgets. This budgeting approach has also been adopted in the revision of the UNECE Gothenburg Protocol (2012) which now allows countries to report national nitrogen budgets as part of their emission reduction plans. [15]

The OECD includes most developed countries across the world including some emerging economies. Similarly, the UNECE includes a substantial part of the northern hemisphere (including North America, Europe, Caucasus and Central Asia). Wider activities related to the nitrogen cycle beyond these domains include the work of GEF and UNEP, including GPA and GPNM, the UN Food and Agriculture Organization (FAO), the UN Framework Convention on Climate Change (UNFCCC) and the UN Convention on Biological Diversity (CBD) and a large number of regional environmental conventions.

Other recent developments in the baseline for nitrogen system indicators can be summarized as follows:

- In 2013 the Our Nutrient World report[16] prepared by GPNM and INI for UNEP delivered a first assessment of crop NUE and full-chain NUE for most countries in the world, and illustrated how improvement in NUE could form the basis for setting aspirational global goals.
- In 2014 the GPNM established a task team on Nitrogen Use Efficiency which has since provided its report that develops consensus on the key input and output terms in defining NUE for crop systems.

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[14] Sutton et al. (2011) *European Nitrogen Assessment*, Cambridge University Press.
[15] UNECE (2013) Guidance document on national nitrogen budgets. http://www.unece.org/fileadmin/DAM/env/documents/2013/air/eb/ECE_EB.AIR_119_ENG.pdf
[16] See footnote 9.

- Also established in 2014 was the EU Nitrogen Expert Panel, which brings together industry, the European Commission, academia and stakeholder representatives (farmers, food supply chain). This group is currently finalizing its reports on Nitrogen Use Efficiency both in cropping systems and across the food system.
- Ongoing work at the OECD has been examining the potential for developing wider NUE indicators that would integrate all sources and actions, including the concept of "Economy Wide Nitrogen Use Efficiency"[17]
- The UN Sustainable Development Goals process currently has NUE marked as a possible indicator linked to Ocean health (Indicator 14.1), which is currently subject of ongoing consultation and review (as of winter 2015/2016).
- The UN Convention on Biological Diversity has developed its Aichi Targets process to include an indicator on Nitrogen Deposition, in partnership with the INI as the delivery agency.[18] This includes a smart phone App of the different indicator performance to support public engagement.

Nitrogen Management Guidance

Key elements include the following in relation to the development of tools and methods for the management of the nitrogen cycle:

- GEF/UNEP Global Nutrient Cycles project, on establishing the foundations for global nutrient management has been developing a Tool Box Approach listing different kinds of good practices for better nutrient management in the form of a web-based application. This can provide a useful source of information for future studies and complements more traditional 'guidance document' based approaches. The project also developed the Lake Chilika report card, which constitutes a visualization approach for summarizing key environmental indicators and showing how a site is performing in relation to these indicators.
- The UNEP report 'Drawing down N_2O' (2013)[19] was developed with input from the INI and GPNM networks and focused on demonstrating the available methods for reducing nitrous oxide (N_2O) emissions in all sectors, including combustion and industry, as well as looking at the opportunities and barriers linked to the developing Green Economy narrative and considering scenarios in to the future. The conclusions strongly emphasized the need to address nitrous oxide emission control in the wider context of managing the global nitrogen cycle, while delivering a suite of mitigation options for further consideration.
- The UN Framework Convention on Climate Change (UN FCCC) includes panels developing best practices for reporting of greenhouse gas emissions. There are several commonalities here with nitrogen, not just in relation to nitrous oxide, but also in developing the systems needed for sound emissions reporting. In this regard the work of the UNFCCC strongly complements that of the Task Force on Emissions Inventories and Projections (TFEIP) of the UNECE EMEP process.
- The FAO is making progress in developing guidance for better management of livestock systems, in particular through its Livestock Environmental Assessment and Performance (LEAP) partnership.[20] This includes development of guidance documents for the livestock sector where better nitrogen management can play a key role.

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[17] Bleeker A., Winiwarter W., Leip A., Sutton M.A. (2011) Potential for OECD to develop a high-level nitrogen indicator. Brief for the Organization for Economic Cooperation and Development, Paris. 4 pp. ECN, Petten, The Netherlands.
[18] CBD (2014) Quick guide to the Aichi Biodiversity Targets. Target 8: Pollution Reduced. https://www.cbd.int/doc/strategic-plan/targets/T8-quick-guide-en.pdf
[19] See note 2.
[20] See http://www.fao.org/partnerships/leap/en/

- The LRTAP convention of the UNECE has published a revised guidance document (2014) on methods to reduce ammonia emissions from agricultural sources. While the focus is on emissions to the atmosphere, it also includes a section on good nitrogen management across the nitrogen cycle in relation to all nitrogen sources and possible impacts.

These examples provide only a selection. However, they illustrate the diversity of relevant actions that provide the baseline for Towards INMS. Other initiatives will be incorporated into the Towards INMS networking as the project develops.

Nitrogen modelling

N use and economic development models are needed to estimate how per capita requirements of N change with economic development in relation to different management, culture, local endowment, development pathways, institutions and mitigation strategies that all influence the nitrogen cycle. These models thus predict N requirements for the production of foods and goods and N emissions in view of energy demand. This can then be compared with the current availability of N and other elements, and the extent in which the yield gap (difference between potential and actual production) in regions can be eliminated by proper agricultural management.

It is anticipated that such models should enable an:

- Assessment of food and feed demand and required crop and grass production for future changes in population growth, dietary patterns and bioenergy/biofuel production (assuming a baseline scenario and variations on it ; demand). Note: Existing scenarios may also be used but this may not allow to estimate the effect of each individual trend, because it involves various combinations thereof. Efforts should then be made to make the new scenarios as consistent as possible with existing scenarios to ensure comparability.
- Assessment of goods and energy demand and required industrial N uses from industrially fixed nitrogen and emitted NO_x for future changes in population growth and ongoing wealthy society, resulting especially in soil N_r accumulation in urban areas and urban air pollution. With economic development, the per capita industrial N use and NO_x-N emission may exceed that of food consumption.
- Comparison of the demand with the current crop and grass production based on the current use / presence of natural resources (current availability of water, fertility of land and supply of fertilizers, biological nitrogen fixation and fixation via NO_x, taking into account climate change (supply).
- Evaluation of the extent in which the yield gap (difference between potential and actual production) in regions could be eliminated to fulfil the demand, based on different assumptions about self-sufficiency.
- Evaluation of the development of Nitrogen Use Efficiency of crops and forage in order to be able to estimate future N requirement for food, feed and biofuel demand.
- Evaluation of the possibilities to alleviate the difference in food supply and demand by changing nitrogen management, including interactions with irrigation and fertilization with other nutrients, also given the finiteness of water and phosphate resources and limited transportation options, particularly in parts of Africa and Asia.

To provide assessments of the different components of nitrogen losses, recycling and nitrogen use efficiency, discussion is needed on which major mitigation and management options have to be considered.

This is important as identification of different mitigation options, has implications for the modelling requirements.

This topic is considered further by De Vries et al. (2015) as part of the INMS Pump Priming workshop, while the figure below gives an indication of the wide range of possible models and how they can link together. [21]

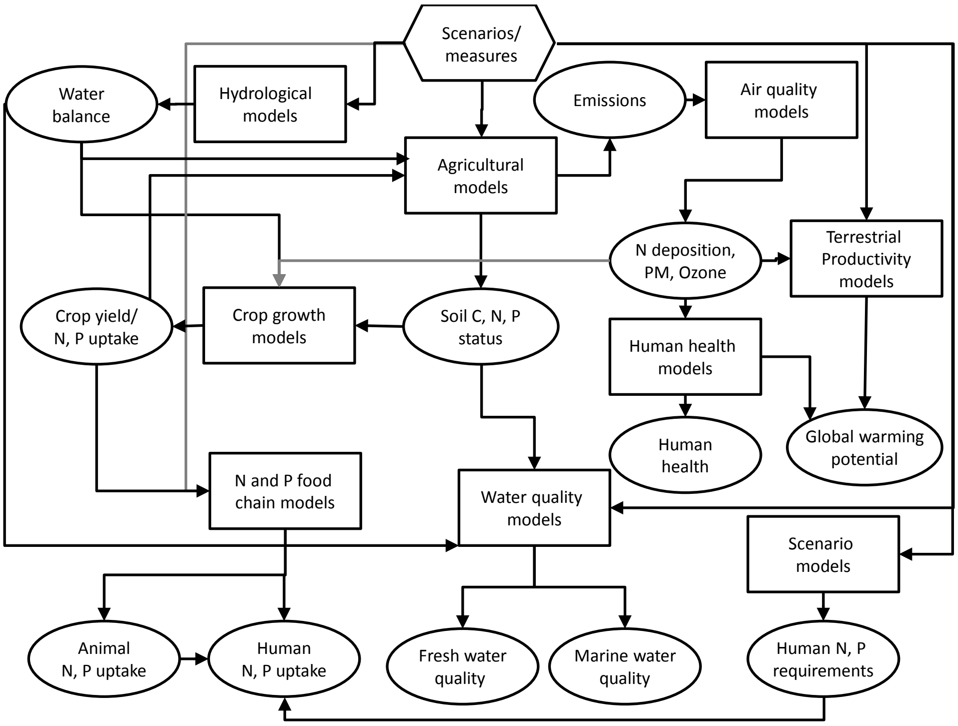

Table A15.1: *Overview of different types of nitrogen model for further consideration within Towards INMS. Key interactions between nitrogen and water availability and other elements are also noted (De Vries et al., 2015).*

2.2.2 Gaps

The main gaps at present in relation to Component 1 are as follows:

- Need to refine **national nitrogen budgeting** approaches to allow their application to a wide range of countries globally, building on the experiences of UNECE and OECD and making it relevant to the needs of other countries.
- Development of **farm scale nitrogen budgets** is necessary, for application in a diversity of countries, and has so far received insufficient attention.
- Development of **NUE approaches** is making progress in several domains. There is a need to build on these different activities and link together the different initiatives, in particular clarifying the different purposes of the different NUE variant approaches.
- Establishing the **relationships between different indicator types** under scenarios of improving nitrogen use efficiency (for different scales and system boundaries) and the change of environmental conditions (reduction in different environmental threats of nitrogen) as well as improvements in targeted outcomes (e.g. food and energy production).

[21] De Vries W. et al. (2015) Background Document 3: How should different compartments of the nitrogen cycle be linked when formulating global nitrogen integrated assessment models? In: Workshop on Needs for Global Nitrogen Integrated Assessment Modelling, Edinburgh, UK 5th & 6th May 2015. http://www.inms.international/inmspp/inmspp-and-tfiam-may-2015/inmspp-background-document-3-issues-compartments

- **Building consensus on definitions and operationalisation of planetary boundaries** for nitrogen including their regionalisation, and the relationship to other nitrogen system indicators.
- There is currently no **agreed methodology for assessing the multiple threats** of nitrogen pollution that crosses different environmental compartments (water, land, air) and different nitrogen forms (e.g. ammonia, nitric oxide, nitrous oxide, ammonium, nitrates, organic nitrogen etc).
- There is currently no **agreed methodology that brings together the different components of nitrogen fluxes** to air, land and water, and their environmental effects. In particular, different communities use different philosophies and concepts which are in some cases contradictory and need to be resolved (e.g. concepts of excess, limiting nutrients, landscape removal etc).
- Approaches for **nitrogen threat benefit valuation** have not yet been brought together between different regional contexts and need especially to be extended to other regions.
- Existing **modelling capabilities need to be brought together** to better understand their complementarities and how they can be used together to support global assessment of the multiple impacts of nitrogen, and establishment of scenarios, allowing improvements in management practices to be recognized.
- The **barriers to better nitrogen management need to be investigated** and options to overcome them explored. This needs to recognize that the barriers are likely to vary regionally, while considering the potential for common barriers and opportunities across regions.

Additional Funding

Further funding is needed to develop each of these areas. This Component of Towards INMS provides a start to address these issues. At the same time the activity provides a framework that can catalyse the development of parallel funding initiatives to further strengthen the global critical mass. Examples of new initiatives that will complement the work include:

- **INMS Pump Priming:** This UK NERC project aims to develop the basis for nitrogen integrated assessment modelling through funding workshops and network development. (A first workshop was already held during 2015 to support the INMS project preparation phase).
- **NEWS India-UK:** This project to be funded by the Newton-Bhabha fund supports bi-lateral research between these two countries, addressing the Nitrogen Efficiency of Whole-cropping Systems (NEWS India-UK). It will provide experimental data and model development that will support INMS Component 1 with evidence on the potential for improved nitrogen management practices. In particular it will address the extent to which there are co-benefits to be found by linking improvement strategies for plant NUE, agronomic NUE, farm-scale NUE and national scale NUE.

Other projects linking to INMS are coming on-stream (e.g. including Newton fund projects) that will further develop the underpinning of the developments in Towards INMS.

2.2.3 Stakeholder analysis

The main stakeholders for Component 1 are those interested in developing improved tools and methods for managing the nitrogen cycle. As such the focus is primarily on bodies with an active engagement in the process from science to policy to practice. Other stakeholders will extend the network through C2, C3 and C4.

Key Stakeholders in Component 1 can be summarized under the following headings:

Nitrogen System Indicators: INI, GPNM, LRTAP, TFRN, EPNB, OECD, EU-NEP, CBD, GPA, SDSN, UNStatistics (re SDGs), SDSN and the various science groups (partners), industries (e.g. fertilizer industry, farming organizations, water management organizations, nature management organizations), NGOs and countries contributing to these processes.

Nitrogen threat and N fluxes methodologies: INI, LRTAP, TFRN, WMO, WHO, GPA, CBD, as well as partners, countries, industries and NGOs.

Global and regional modelling of the nitrogen cycle: INI, Future Earth, LRTAP Hemispheric Task Force (HTAP), LOICZ, implemented through partner members.

Cost benefit analysis and barriers to better nitrogen management: INI, GPNM, GPA, TFRN, LRTAP, CBD, SDSN, OECD, EU-NEP, PROBAPS, industry, academia, NGOs and countries through these processes.

The roles of the different stakeholder groups can be summarized as follows:

Government and international agreements: The international agreements provide a mechanism for INMS to engage with governments, mobilizing them with the opportunities offered by better nitrogen management. In this sense they represent both users of the work and a source of international advice and feedback on priorities for action. In practice, representatives of these processes provide advice to Towards INMS, while INMS reaches out to support their processes.

Private Sector: The private sector provides a sounding board in relation to their own business interests and what opportunities they see to strengthen competitiveness. Several business organizations are involved including the International Fertilizers Manufacturers Association, Fertilizers Europe, BASF, Yara, the International Plant Nutrition Institute, as well as other business organizations such as the European Federation of Agricultural Engineers, with farmer groups being involved through Component 3.

Wider stakeholder involvement with NGOs will particularly come through Components 3 and 4. However, relevant stakeholders in relation to the methods include the science community – represented first of all by INI, but reaching out to Future Earth and the Planetary Boundaries Initiative.

2.3 Overall objective and outcomes

Component 1 forms a key part of Towards INMS contributing to its **Overall Project Objective:**
To improve the understanding of the global/region N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems.

Specifically Component 1 will lead to the following outcomes:

Outcome 1.1: Stakeholders, including policy makers, scientists, industry, farmers, business and civil society, have an agreed basis for informed decision making on N cycle management.

Outcome 1.2: Stakeholders using agreed assessment and quantification methods to evaluate N cycle status acting as a common basis for regional / global scenarios to guide management actions.

Both of these outcomes must be seen in the wider context of the project. The focus is on *developing the methods and consensus on these methods* since these provide the critical foundation for subsequent decision making.

2.4 Activities and Outputs

Overall Component Co-Leads: North American Center of INI (Baron, USGS) and European Centre of INI (van Grinsven, PBL)

2.4.1 Activity 1.1 : Nitrogen System indicators

Output 1.1 Indicators developed for assessing full N budgets, use, levels and impacts, including N use efficiency and benchmarking. Indicators to be developed of relevance for specific stakeholders.

Activity Co-Leads: European Centre of INI (Winiwarter, IIASA) and North American Center of INI (Baron, USGS).

The elements of this activity are summarized visually in Figure A15.1. This activity brings together a range of different approaches to indicating the status of the the nitrogen cycle from local to regional scales. In particular, it complements the development of indicators of the nitrogen system – i.e. those that look at all the different component nitrogen fluxes and levels to analyze the system – and those that address specific effects. This latter group includes both effects related to benefits of nitrogen use (e.g. food, feed and energy production) as well as those related to adverse effects (e.g. water pollution, air pollution, greenhouse gas emissions, loss of biodiversity and soils). Task 1.1.1 and 1.1.2 focus on developing the component of nitrogen budgets, including harmonization of system definitions and required datasources at national and farm scales. This will also need to reflect on the different sector levels – with Task 1.1.1 covering all economic sectors. Task 1.1.3 focuses on the ways to intepret such nitrogen budgeting approaches. Specifically the use of NUE, representing N outputs in useful products divided by N inputs is one way to look at these systems, while N balance is another way, in this case looking at N inputs minus N outputs in products. A key challenge here is to define system boundaries in a way to allow both meaningful conclusions from the indicators and obtain robust results from potentially diverse input information. In the Task 1.1.4 efforts are then placed to show how the different N system indicators relate to the different effect based indicators. For example, exploring how reductions in N surplus and improvements in NUE link to reduction in adverse environmental effects and can simultaneously contribute to improving food and energy production.

Overall, it is expected that this activity will lead to several reports on methologies for nitrogen system indicators, for adoption by partners during plenary meetings of INMS. In addition, it is expected that key products and their synthesis will provide important material to support the global assessment process (Activity 2.3).

Each of the four **Tasks** is associated with a specific **Task Output**.

Task 1.1.1: Development of national nitrogen budget approaches.

Task Output 1.1.1: Guidance Document on National Nitrogen budgets

Task Co-leads: INI Europe (Winiwarter, IIASA) and Japanese Nitrogen Expert Group (Hayashi, NIAES)

The main focus of this activity is to further test and develop national nitrogen budget approaches and documentation. The starting point will be a review of the existing guidance developed by the UNECE on National Nitrogen budgets (prepared under the lead of EPNB and OECD). These approaches will be compared with those that may be developing in other regions, in order to build common understanding in the complementary purposes of the different approaches and consensus on the target outcomes. This will highlight how national nitrogen budgets can be used to support development of national nitrogen strategies including priority identification and areas for maximum economic gains. As part of this work, through co-financing from partner countries, expertise will be shared from countries that have already established national budgets (e.g. Germany, Canada, Denmark, France, US, Switzerland) with new budgets established for other countries (e.g. India, China, Japan) which will complement the regional demonstration activities of Component 3. The guidance document will in addition take a close look on the comparibility of results across different climate conditions, economic situations and accessibility of underlying statistical or other relevant information. Overall, this Task will support the implementation of common approaches to nitrogen budget development across Component 3.

Several INMS partners have proposed to contribute to this Task including: IIASA, OECD, UED (UK), ALTERRA (Netherlands), ASU (Lithuania) AU-Envs (Denmark), ENEA (Italy), US EPA (USA), VU (The Netherlands), WUR LR (The Netherlands), ECN (The Netherlands), AU Agro (Denmark), AU Bios (Denmark), FAO-AGRO, JRC (Europe), MU (USA), NERC (UK), PIK (Germany), RRes (UK), ILRI, LVBC (Uganda), INRA (France), NANC (USA),

The following have expressed interest to provide advice and review the work accomplished in this Task: INRA (France), UBA (Germany).

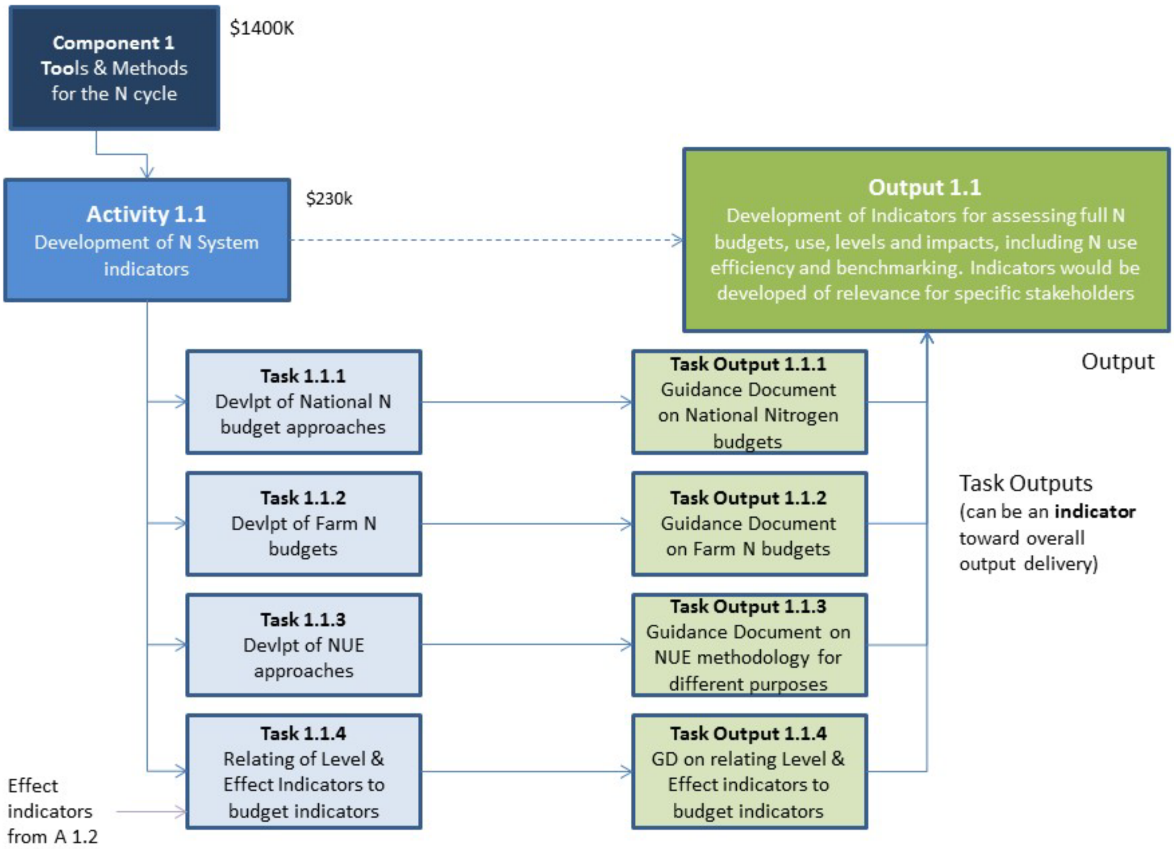

Figure A15.1: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation nitrogen system indicators (Activity 1.1; Output 1.1).*

Task 1.1.2: Development of farm nitrogen budgets

Task Output 1.1.2: Guidance Document on Farm Nitrogen budgets

Task Co-leads: INI (Gourley, DEDJTR Victoria, Australia) and TFRN (Misselbrook, BBSRC).

Concepts for establishing farm scale nitrogen budgets have been developed by several organizations, but so far there has been little attempt to bring together the different approaches and views on system boundaries. This activity will bring together INMS partners with an interest in this area to develop common principles for estimating farm scale nitrogen budgets, especially in reflection of the different purposes for which such budgets may be used (e.g. implementation by farmers, farm adivisors or environmental managers). In order to provide a first focus for this new activity with available resources it is planned to focus in Towards INMS on farm scale nitrogen budgets for dairy farm systems. This will draw in expertise from Australasia, West Europe, East Europe, North America, East Asia and South Asia. To the extent that additional resources can be identified as Towards INMS develops, the activity may be extended for other regions and farm types.

Several INMS partners have proposed to contribute to this Task including: DEDJTR (Australia), RRes (UK), ALTERRA (The Netherlands), ASU (Lithuania), AU-Envs (Denmark), VU (The Netherlands), ATB (Germany), BRRI (India), AU-Bios (Denmark), EPA (USA), MU (USA), INRA (France), Ag-HU (Japan), AgResearch (New Zealand), WUR LR (The Netherlands), AU Agro (Denmark), JRC (Europe).

The following have expressed interest to provide advice and review the work: CIMMYT, UBA (Germany), ECN (The Netherlands), FAO-AGA (International), IIASA (Austria)

Task 1.1.3: Development of nitrogen use efficiency approaches

Task Output 1.1.3: Guidance Document on NUE methodology for different purposes

Task Co-leads: EU-NEP (Oenema, WUR, Netherlands) and OECD (Lynster).

The purpose of this activity is to bring together existing initiatives that address nitrogen use efficiency from different perspectives and further develop consensus on approaches and formulation of NUE variants in relation to different user needs. Key tasks will include extending between different system boundaries (e.g. Crop NUE, Livestock NUE, Food Chain NUE, Economy-wide NUE etc), and at different spatial scales (farm, watershed, airshed, country, region etc.), and to work towards developing benchmarking of these indicators, distinguishing current basline performance compared with technically achievable goals under present and future conditions. The output will focus on producing a guidance document on NUE methodology for different purposes and to support discussions for different user groups, from farms, industry, foodsupply, governments etc.

Several INMS partners have proposed to contribute to this Task including: ALTERRA (NL), OECD, BBRI (Bangladesh), RRes (UK), INRA (France), ECN (The Netherlands), FAO-AGA (International), IIASA (Austria), UoY (UK), VU (The Netherlands), WUR LR (The Netherlands), Fertilizers Europe (on behalf of the EU Nitrogen Expert Panel), MU (USA) AgResearch (New Zealand), DEDJTR (Australia), AU Agro (Denmark), JRC (Europe), CIMMYT, ISA (Portugal), CARR (China)

The following have expressed interest to provide advice and review the work: ASU (Lithuania), PBL (The Netherlands), LRTAP, CBD, GPNM.

Task 1.1.4: Relating of Level & Effect Indicators to budget indicators

Task Output 1.1.4: Guidance Doc. on relating Level & Effect indicators to budget indicators

Task Co-leads: INI North America (Baron, USGS) and INI Europe (Winiwarter, IIASA).

While there is substantial emerging interest in new kinds of nitrogen indicators, such as based on NUE and nitrogen balances, there is an ongoing need to relate the different kinds of available indicators. Other kinds of indicators on different scales (farm, nature area, city, river, region, country) include N emissions, concentrations of N components in water and air, deposition of N components, N inputs from agricultural soruces including fertilizer and biological nitrogen fixation, ecooystem response indicators such as species changes, and productivity indicators (e.g. food produced, estimated damage due to N pollution, estimated health threat and ecosytem threat etc).

As Towards INMS seeks to build the bridges between the different benefits and threats of nitrogen management it becomes even more important to be able to understand and predict the relationships between the different indicator types. For example, will a proposed management strategy show improvements in performance for some outcomes but not all? When will improvements in NUE lead to improvements in environmental quality, but are there some situations where this would not be the case? Can indicators be harmonized across different agricultural systems to provide meaningful comparisons? To address these issues, the activity will work on preparing a guidance document focused on non-specialist audiences (governments, land managers, stakeholders) that clarifies the distinct purpose of the different nitrogen indicator types, and illustrates examples of how they relate to each other. To establish the relationships it is expected that it may be necessary to consider the outcomes of particular scenarios, which will be conducted in cooperation with Activity 2.4.

INMS partners proposing to contribute to this activity include:NANC (USA), IIASA, ATB (Germany), ECN (The Netherlands), ALTERRA (The Netherlands), VU (The Netherlands), NERC (UK), CIMMYT, CARR (China), OECD.

The following have expressed interest to provide advice and review the work of this task: INRA (France), UBA (Germany), FAO.

2.4.2 Activity 1.2 : Development of Threat Assessment Methodology

Output 1.2 Methodology for Nitrogen Threat Assessment.

Activity Co-Leads: INI North America (Baron, USGS) and ILTER (Shibata, Japan).

The elements of this activity are summarized visually in Figure A15.2. The work here recognizes that nitrogen has multiple adverse effects on the environment. These include effects via losses of nitrogen from multiple sources including farming systems, combustion systems (for energy, transport and industry) and waste water systems. Effects have been summarized by the ENA and Our Nutrient World under a simple model: WAGES: Water, Air, Greenhouse balance, Ecosystems and Soils. These include effects on human health and ecosystems, including consequences with adverse effects on economic productivity (health, crops losses, loss of coastal productivity).

Recognizing this complexity, this activity will work to bring the science communities addressing these separate issues more closely together as a basis to better understand each others issues and to identify the links between them. Specifically, it is recognized that there are different philosophical paradigms adopted by different communities and these paradigms need to be confronted and better understood. For example, catchment scientists may talk of ‘watershed retention’ being the amount of nitrogen that is retained in catchments so that it does not contribute to water pollution. However, from a different perspective high catchment retention of nitrogen may mean high losses of nitrogen compounds to air pollution, contributing to other threats. Similarly, even though denitrification to N_2 is considered environmentally benign, it wastes a substantial amount of the energy (and money) used in producing reactive nitrogen compounds (via fertilizers or biological nitrogen fixation). Denitrification to di-nitrogen (N_2) will also often be associated with higher denitrication to the greenhous gas nitrous oxide (N_2O). These example illustrate how different perspectives need to be brought together across the nitrogen cycle to develop a more comprehensive basis for threat assessment.

A concept or rationale that is relevant here is the concept of critical loads of nitrogen, that has been applied for non-agricultural soils and used in air pollution policies. Similarly critical loads of nitrogen (possibly interlinked with phosphorus) can be derived for agricultural soils based on an acceptable : (i) N (and P) runoff in view of surface water quality, (ii) nitrate (NO_3) leaching, in view of drinking water quality.(iii) ammonia (NH_3) emission in view of biodiversity impacts caused by NH_3 deposition on neighbouring nature and (iv) nitrous oxide (N_2O) emission in view of climate change. Such integrated critical N loads can be derived both at farm and regional scale, the latter being regional N boundaries, which aggregate up to a planetary N boundary when applied all over the globe.

INMS partners proposing to contribute to this activity include:NANC (US), NIAES (Japan), ALTERRA (The Netherlands), VU (The Netherlands), Fertilisers Europe (Europe), ENEA (Italy), UBO (Germany), UoY (UK), PBL (The Netherlands), OECD, NERC (UK), ISA (Portugal), IIARI (India), CARR (China).

The following have expressed interest to provide advice and review the work: UBA (Germany), FAO.

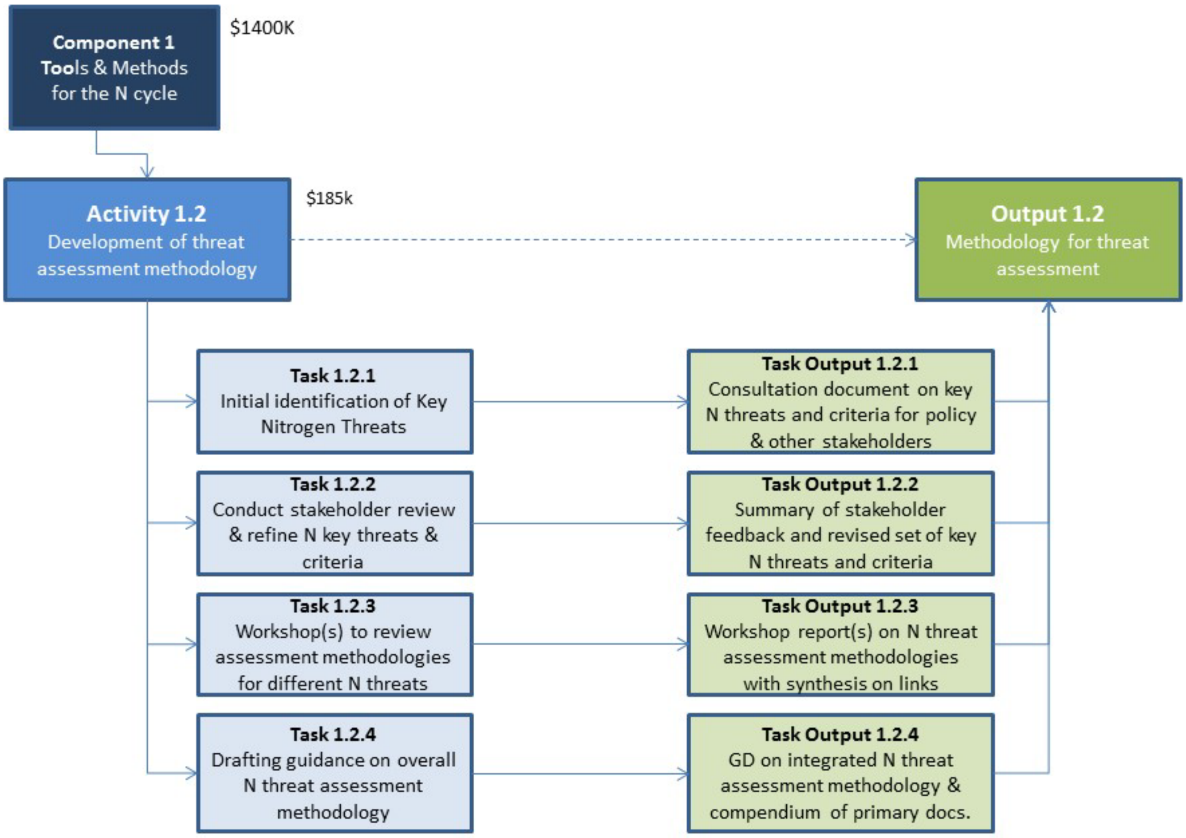

Figure A15.2: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation nitrogen system indicators (Activity 1.2; Output 1.2).*

The work of **Activity 1.2** is structured as four distinct **Tasks**, each with a specific **Task Output**:

Task 1.2.1: Initial identification of key nitrogen threats

Task Output 1.1.1: Consultation document on key N threats and criteria for policy & other stakeholders

Task Co-leads: INI Europe (van Grinsven, PBL) and INI (Howard).

Progress has already been made in starting on this task through the Edinburgh Workshop (May 2015) of the INMS Pump Priming project, during the Towards INMS Project Preparation phase. The conclusions from that workshop form the starting point for further development. Specifically, the initial findings will be reviewed and then shared with the INMS community and stakeholders to ask whether all appropriate issues are being addressed, whether some issues are priorities among others, and how these priorities may differ according to region. In this regard, the developing INMS Regional Demonstrations will be used as a sounding board for ideas on regional differences, while priority identification will need also to involve policy stakeholders in different countries. Hence a consultation document will be produced to allow first testing and and feedback to support the next steps on methodologies for the different priority threats identified.

Task 1.2.2: Conduct stakeholder review & refine N key threats & criteria

Task Output 1.2.2: Summary of stakeholder feedback and revised set of key N threats and criteria

Task Co-Leads: INI North America (Baron, USGS) and ILTER (Shibata, Japan).

Based on internal review of the consultation document from Task 1.2.1, this task will direct the consultation process itself. It will aim to mobilize input from each of the different INMS Regional Demonstrations, including a wide range of stakeholders from science communities, to governments and business stakeholders. The feedback will be summarized in the form of a reflection on the inputs received, as well as a database on the feedback itself. The process will encourage respondees to start identifying the links between different threats, indicating how a more joined up threat assessment methodology could provide wider benefits by identifying synergies and trade-offs through the nitrogen cycle.

Task 1.2.3: Workshop(s) to review assessment methodologies for different N threats

Task Output 1.2.3: Workshop report(s) on N threat assessment methodologies with synthesis on links

Task Co-Leads: INI North America (Baron, USGS) and ILTER (Shibata, Japan).

The information from Task 1.2.2 will serve as input to a special workshop which will bring together technical experts on threat assessment methodologies for the different component issues, as well as policy and other stakeholders to provide their views into the process. The consultation outcomes will be used to design the workshop structure that seeks to move from a single threat perspective to a more integrated perspective that highlights the synergies. The workshop will particularly draw on cases of good practice showing how the links can be made. Background documents will be prepared in advance on specific cases illustrating joining up of threat assessment methodology for nitrogen and also draft contributions to an eventual joined-up guidance document. It is anticipated that this will be done in the form of a main workshop, but this may also be supported by a preparatory workshop of lead authors, and a subsquent workshop of lead authors synthesizing the results, where this is necessary.

Task 1.2.4: Drafting guidance on overall N threat assessment methodology

Task Output 1.2.4: Guidance Document on integrated N threat assessment methodology & compendium of primary documentation

Task Co-Leads: INI North America (Baron, USGS) and ILTER (Shibata, Japan).

The process of drafting the Guidance Document on nitrogen threat assessment is expected to be delivered through several stages as follows: a) based on the initial review of issues and the consultation (Tasks 1.2.1, 1.2.2) lead authors will be invited to prepare a set of background documents for the workshop, which will form a basis for discussion of contents on the eventual background document. b) The findings of the workshop will identify issues for revision and may also identify gaps which need to be addressed. c) The background documents will be revised in the form of chapters of the eventual INMS Guidance Document on integrated nitrogen threat assessment methodology. This guidance Document will also include a compendium of primary documentation of different components of nitrogen threat assessment methodology. d) The draft final Guidance Document will be presented to an INMS Plenary Meeting for approval pending any final revisions. c) The final document will be published by INMS in coordination with the contributing organizations using resources identified in Activity 4.5. It is anticipated that the process may also stimulate other publications in the scientific literature. The outputs of this activity are also expected to be useful for the the global assessment process (Activity 2.3).

2.4.3 Activity 1.3 : Develpt of methodology for N fluxes and distribution

Output 1.3 Methods for determining N fluxes and distribution (water, air, land, agriculture, industry etc)

Activity Co-Leads: UNECE Task Force on Measurement & Modelling (Braban, NERC) and INI (Sutton, NERC) [alternative nominations for this task would be welcome: Durand? Pathak? Bustamante?

The elements of this activity are summarized visually in Figure A15.3. As with the previous activity, the importance of this work lies in the multiple pathways and adverse effects of nitrogen in the environment. The different N flows include via human transfers (fertilizers and other N inputs or recycled products, trade in products), emissions to the atmosphere, atmospheric transport, atmospheric deposition, immobilization, leaching and run-off, catchment flows, inputs into estuarine and coastal environments, marine upwelling and denitrification. Different scientific traditions and methodologies are associated with the measurement of each of these component nitrogen fluxes, and equally with approaches for asessing the distribution of fluxes and concentrations. These different traditions result from the specialisation of different research and monitoring communities, with the result that different conventions have developed which often lead to confusion when developing more integrated perspectives. For example, not only do the conventional paradigms differ (e.g. 'threats of excess' or 'nutrient limitation'), but the sampling approaches and units used between disciplines differ. Each of these issues needed to be addressed in developing a more joined up methodology for nitrogen fluxes and distribution. This activity will lead to an INMS guidance document on flux and distribution methods including a compendium to enable access to primary documentation on the component forms of N fluxes, concentrations and their distribution.

INMS partners proposing to contribute to this activity include: NERC (UK), ALTERRA (The Netherlands), VU (The Netherlands), ENEA (Italy), UGENT (Belgium), WUR LR (The Netherlands), FAO AGA, INRA (France), BFU (China), RIVM (The Netherlands), NANC (USA), Aarhus Univ (Denmark), University of York (UK), ISA (Portugal), IIARI (India), JRC (EU).

The following have expressed interest to provide advice and review the work: UBA (DE), ADEME (FR), PBL (NL), FAO, WMO.

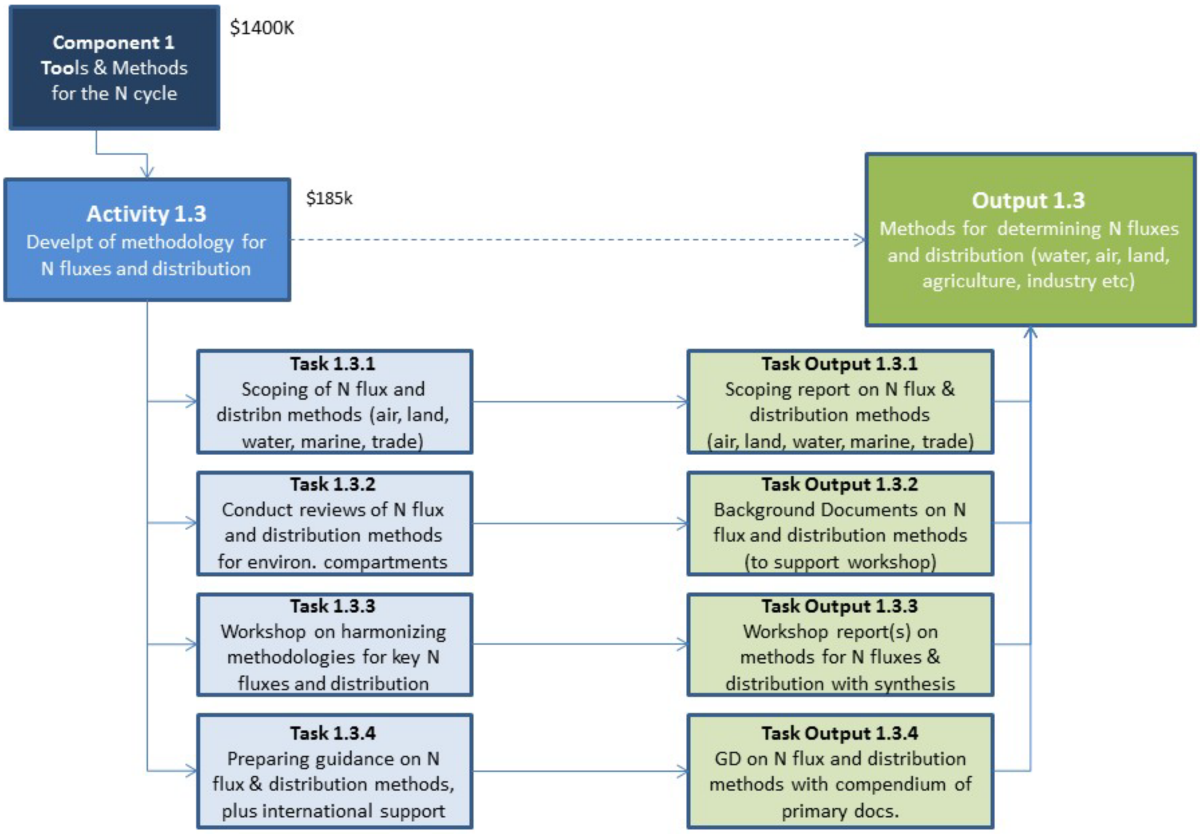

Figure A15.3: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation nitrogen system indicators (Activity 1.3; Output 1.3).*

Task 1.3.1: Scoping of N flux and distribution methods (air, land, water, marine, trade)

Task Output 1.3.1: Scoping report on N flux & distribution methods (air, land, water, marine, trade)

Task Co-Leads: Braban (TFMM, NERC), Sutton (INI, NERC) [This is open for other volunteer leads]

Partners from across the INMS network will be invited to develop a first scoping of the main methods for measuring and assessing nitrogen fluxes and distribution. This task will bring together a small group of experts from air, land, water, marine and trade areas to develop the approach. A particular focus will be given to measurement strategies that set the different fluxes in context of each other, as well as in datasets that are required to support upscaling approaches. The scoping report to be produced will serve to highlight the key issues that need to be considered, including the need to clarify agreed meaning of measurement parameters, definitions and preferred units so as to promote improved cooperation of underpinning research and monitoring activities across the nitrogen cycle. It is anticipated that this task will benefit from a small planning meeting, with the scoping report highlighting the next steps needed in relation to the subsequent tasks and identification of priority background documents. This will provide the basis to commission background documents and agree the format of the workshop on nitrogen flux and distribution methods (Tasks 1.3.2, 1.3.3). The scoping review would be circulated across the INMS network to encourage feedback and involvement in the next steps.

Task 1.3.2: Conduct reviews of N flux and distribution methods for environmental compartments

Task Output 1.3.2: Background Documents on N flux and distribution methods (to support workshop)

Task Co-Leads: Braban (TFMM, NERC), Sutton (INI, NERC) [This is open for other volunteer leads]

Based on the feedback to the scoping review, the planning team for this Activity would commission a group of background documents that will summarize and synthesize different nitrogen flux and distribution methods. These documents are conceived as providing draft chapters in an eventual "INMS Guidance Document on Nitrogen Fluxes" (Task 1.3.4), and will need to be structured according to component topics with this in mind. While a decision on the ultimate division of structure must wait until the scoping report is produced (Task 1.3.1), it is anticipated that the documents should help consideration of a) all environmental compartments and and their relationships, b) encourage readers to see across the boundaries between environmental comparements, c) developing a common approach between chapters / background documents that facilitates comparison, d) issues of where paradigms and measurement units conflict (and seek to resolve or clarify), e) providing access to primary literature that gives methodological approaches in more detail.

Task 1.3.3: Workshop on harmonizing methodologies for key N fluxes and distribution

Task Output 1.3.3: Workshop report(s) on methods for N fluxes & distribution with synthesis

Task Co-Leads: Braban (TFMM, NERC), Sutton (INI, NERC) [This is open for other volunteer leads]

The background documents prepared will form key inputs to a workshop that addresses the harmonization of methods for key nitrogen fluxes. A particular emphasis will be given to measurement approaches crossing different parts of the nitrogen cycle, but also for considering other supporting datasets that are needed to intepret measurements as well as inform model development. (This activity is not, however, primarily a modelling activity, as this is addressed in Activity 1.5.). Discussions at the workshop will serve to highlight gaps and challenges, while bringing nitrogen scientists together with interests across the nitrogen cycle, including freshwater, marine, terrestrial and atmospheric scientists and those interested in other N flows, such as through trade. The approach will continue to focus on what can be most useful to record in the form of a guidance document to stimulate better harmonization of methods.

Task 1.3.4: Preparing guidance on N flux & distribution methods, plus international support

Task Output 1.3.4: Guidance Document on nitrogen flux and distribution methods with compendium of primary documents

Task Co-Leads: Braban (TFMM, NERC), Sutton (INI, NERC) [This is open for other volunteer leads]

Following the workshop, the background documents will be revised and extended according to the outcomes of the discussion. These will be assessmbled together including an overall executive summary of the key messages emerging, and a listing of the target audiences of the document. The draft final document will be presented to a plenary meeting of INMS for review and approval, after which it will be published by INMS in cooperation with the contributing organizations. The publishing itself is covered under Activity 4.5. It is anticipated that the process may also stimulate other publications in the scientific literature. The outputs of this activity area are also expected to be useful for the the global assessment process (Activity 2.3).

2.4.4 Activity 1.4: Development of approaches for threat-benefit valuation
Output 1.4 Approaches to estimate the value of N threats and benefits

Activity Co-Leads: INI Europe (van Grinsven, PBL) and INI East Asia (Baojing Gu, Univesity of Zhejiang)

The elements of this activity are summarized visually in Figure A15.4. This work builds on first steps to developing approaches to value the threats and benefits of nitrogen use and release into the environment. Threat benefit valuation is a method to express various issues in a common unit, allowing the comparison of different N impacts. By choosing monetization as the method, this theortically also allows expression of N threats as a welfare loss and, as a next step, to compare cost of N mitigation to the benefits of reduced (negative) N impacts. Recent valuation studies include those of the European Nitrogen Assessment[22,23], further improved by the ECLAIRE and PROBAPS projects, with parallel studies available for the United States[24] and China[25].

These studies included efforts to value the different threats of nitrogen pollution to water, to air, to land, including climate, health and ecosystems effects. Examples are the polluting effects of nitrogen in ground, surface and coastal waters, the health effects of nitrogen emissions to air in particulate matter, the health effect of stratospheric ozone depletion from nitrous oxide and the ecosystem effects of atmospheric nitrogen deposition. Steps have also been made to extend these studies to consider the comparative benefits of nitrogen use in agriculture.

Such studies provide a key vehicle for developing public communication about the nitrogen cycle and for stimulating policy debate. By definition, the results tend to be rather contentious, especially given the difficulty to compare essentially non-commensurate quantities. Nevertheless, this does not detract from their power in raising awareness that can feedback both to improve cost-benefit valuation and inform other parts of nitrogen cycle quantification and strategy development.

The first challenge for this activity is to bring together global expertise as a basis for developing common approaches between regions so as to make regional assessments as far as possible comparable. This necessarily raises challenges in valuation studies that particualrly apply when comparing different economies, that impose also on ethical questions such as econonomically driven differences in the apparent value of human life and environment according to location. The activity will develop the thinking for nitrogen in this area, while ensuring that the work is well linked to other global and regional initiatives in environmental economics (e.g. ECLAIRE and TEEB).[26]

INMS partners proposing to contribute to this activity include: PBL (The Netherlands), University of Zhejiang (China), ENEA (Italy), INRA (France), BFU (China), University of York (UK), Aarhus University (DK), NERC (UK). Further groups will be included in the activity as the work develops.

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[25] Gu B., Ge Y., Ren Y., Xu B., Luo W.m Jiang H., Gu B. and Chang J. (2012) Atmospheric reactive nitrogen in China: Sources, recent trends, and damage costs. Environ Sci Technol **46**(17), 9420–9427.
[26] http://www.teebweb.org/agriculture-and-food/

The following have expressed interest to provide advice and review the work: RIVM (The Netherlands), FAO-AGA (International).

The following have expressed interest to provide advice and review the work: RIVM (NL), FAO, ISA.

Task 1.4.1: Review of existing threat benefit valuation studies

Task Output 1.4.1: Status report on N threat benefit valuation identifying key gaps & challenges

Task Co-Leads: van Grinsven (PBL) and Baojing Gu (University of Zhejiang)

The first Task of this activity will be to review existing approaches to valuing threats and benefits. While the focus is on nitrogen, this will necessarily draw on work in linked research areas so that they can be applied for the nitrogen case. A core team of INMS partners and other contributors will be invited to contribute to this document that summarizes the current status, identifies key gaps and clarifies the primary challenges that INMS needs to work on during this phase. The outcome of this first task will be an INMS working document to encourage review and reactions by other INMS partners and stakeholders. This will then set the agenda for the next steps of the analysis.

Note that with the INMS and partner resources available for this component, it is planned that meetings of the partners would be aligned to the main INMS plenary meetings. If additional resources become available, it will be considered whether it is possible also to fund a specific workshop on this topic.

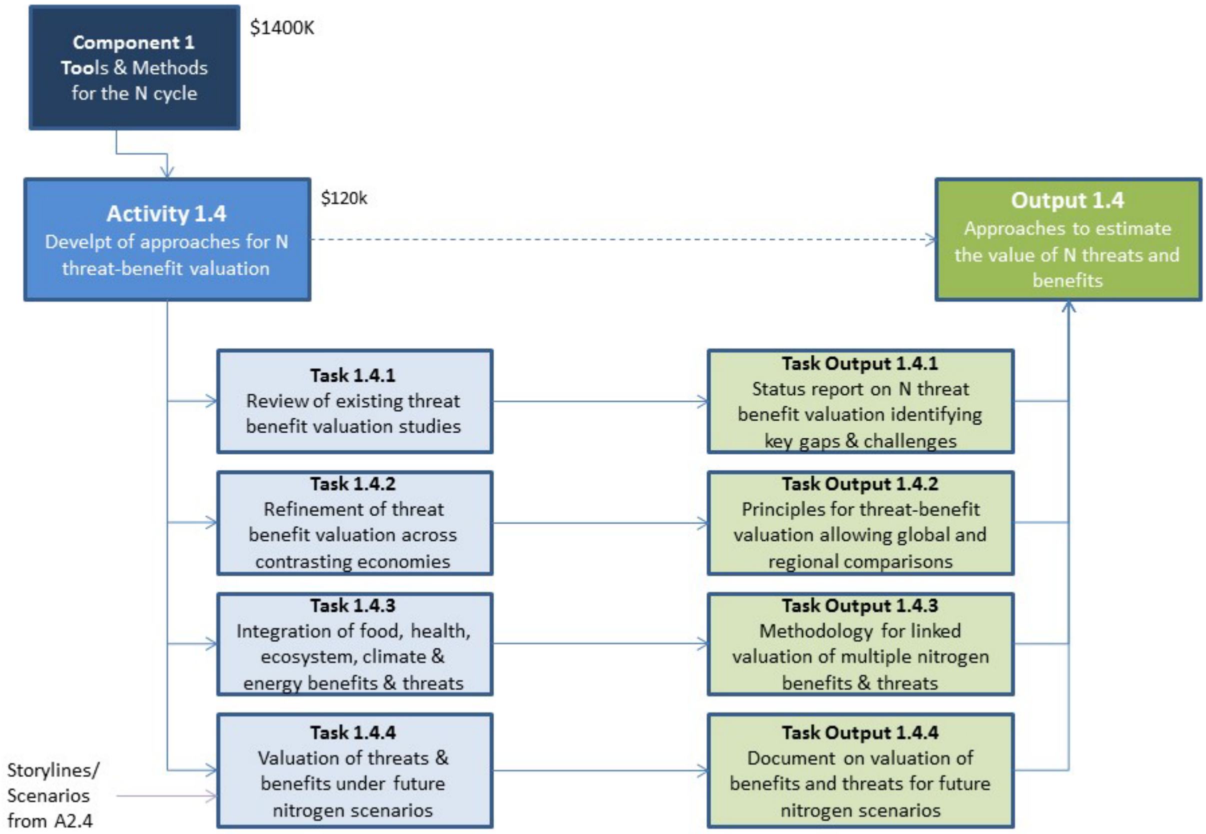

Figure A15.4: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation nitrogen system indicators (Activity 1.4; Output 1.4).*

Task 1.4.2: Improvement of threat benefit valuation methods, including refinement across contrasting economies

Task Output 1.4.2: Principles for threat-benefit valuation allowing global and regional comparisons

Task Co-Leads: van Grinsven (PBL) and Baojing Gu (University of Zhejiang)

Following the initial review, this task will examine how to address the benefits and threats of nitrogen across contrasting economic conditions. For this purpose, it is anticipated to compare examples from Europe, China and the US in the first instance. However, where data become available it may be possible to extend this through involvement of other INMS regional demonstrations (Component 3). The output from this activity will be a summary document in the form of an INMS briefing note that summarizes the main principles of threat-benefit valuation when conducting this across contrasting economies. This will serve to inform the improvement of estimates in other regions, identifying the priorities for new primary data, and for improving global estimates.

Task 1.4.3: Integration of food, health, ecosystem, climate & energy benefits & threats

Task Output 1.4.3: Methodology for linked valuation of multiple nitrogen benefits & threats

Task Co-Leads: van Grinsven (PBL) and Baojing Gu (University of Zhejiang)

This task focuses on bringing together different types of nitrogen threats and benefits. It will consider how different valuation approaches can be applied and the strengths and limitations of different concepts, especially when comparing different impact types. The outcome will be to develop the methodology for nitrogen threat-benefit valuation that that is illustrated for selected domains, and that can provide a foundation to be implemented in other regions. The annual eurobarometer surveys assigned by the European Commission and which include surveys of environmental concerns in the broad context of socio-economic concerns, may provide additional insight to both improve valuation estimates and regionalize valuation.

Task 1.4.4: Valuation of threats & benefits under future nitrogen scenarios

Task Output 1.4.4: Document on valuation of benefits and threats for future nitrogen scenarios

Task Co-Leads: van Grinsven (PBL) and Baojing Gu (University of Zhejiang)

This task represents an application of the developed methodololgy to future conditions. It will be conducted in coordination with Activity 2.4 which will develop future nitrogen scenarios for Towards INMS. Based on the agreement of selected scenario(s), the nitrogen cost-benefit methodology will be applied for future conditions, for the example regions and, as far as possible, also providing the global scale estimates and implications. Depending on the outcome of the Activity on future scenarios, it is anticipated that this Task may address both the costs and benefits of the business as usual scenario (BAU) and make provisonal comparisons with future scenario(s) of what could happen under alternative situations in the future (sustainable development (SD), convergence of GDP, education, technology, resource efficiency and eventually WTP to prevent N impacts). In order to accomplish this, given the additional uncertainties for future conditions (e.g. 2050, 2100), it may be necessary to prioritize on the major future costs-benefits, giving less attention to issues where the prior analysis (Tasks 1.4.1-1.4.3) have shown only minor cost implications.

The outputs of this activity area are expected to lead to peer review INMS reports and publications. They are also expected to be useful for the the global assessment process (Activity 2.3).

2.4.5 Activity 1.5: Flux-impact path models for assessment, scenarios & strategy evaluation

Output 1.5 Approach to using existing N flux/pathway models for global/regional assessments and visualisation for potential scenarios

Activity Co-Leads: INI Europe (de Vries, ALTERRA, WUR) and TFRN (Winiwarter, IIASA)

The purpose of this activity (visualized in Fig. A15.4) is to develop a coordinated approach to modelling nitrogen flows and impacts at global and regional scales. Numerical models provide valuable tools to support decision-making in relation to the environment with a wide range of models already existing. In most cases, however, existing nitrogen modelling capability has been split between issues that have become separated through specialisation into to specific topics. The core challenge is therefore to foster stronger cooperation between modellers with expertise in different parts of the nitrogen cycle, in order to provide a foundation for more comprehensive assessment of impacts on global and regional scales. Work is firstly needed to review the available modelling capability and to bring different areas of expertise together. As part of this, criteria for model suitability need to be developed according to the purpose. Here the focus is on delivering a suite of modelling tools that can work together to indicate the scale of threats and benefits, their spatial distribution at global and regional scale and the potential for the adoption of management options to be reflected in the models as a basis to show how they can improve conditions (reduce adverse effects, increase benefits). The models must be able to sit within temporal context, and be applicable for both examination of present conditions and future scenarios. Although the reconstruction of past conditions (or even past scenarios) is not a goal set for Towards INMS at this stage, suitability for this purpose is also a relevant criterion in considering model selection.

A start in this activity has already been made during the Towards INMS Project Preparation phase using funds provide through the INMS Pump Priming Workshop (Edinburgh, May 2015). This has allowed a first examination of different modelling approaches, including starting to bring the different areas of expertise together. In order to encompass all the key issues on the global nitrogen cycle, it is evident that models need to include:

- Defining and delineating human drivers impacting on the global/regional nitrogen cycles
- Human activities in the terrestrial zone, including N turn over processes in agricultural, (semi)natural and urban constexts
- Human activities in the freshwaters and marine environments, including catchment and coastal processes.
- Quantification of major inputs of reactive nitrogen, including fertilizer production, biological nitrogen fixation and formation of nitrogen oxides in combustion sources
- Quantification of target N flows and benefits to useful products including to food, feed, fibre, energy and and other benefits. A distinction is necessary between different kinds of food and feed (including plant, animal, dairy, fish) in order to trace the effects consumption choices
- Quantification of emissions / losses of nitrogen into the environment, with priority for the major N flows, including combustion sources, soils, livestock, water surfaces, including natural sources, as far as feasible considering all relevant N forms (ammonia, ammonium, di-nitrogen, nitrous oxide, nitric oxide, nitrates etc).
- Quantification of N flows and impacts in terrestrial ecosystems, including N turn over processes in agricultural, (semi)natural and urban contexts
- Quantification of N flows and impacts in freshwaters and marine environments, including catchment and coastal processes.

- The effects of human management decisions both in terms of activities and their distribution and a suit of possible options for improvement in management, enabling the benefits of improved management to be accounted for.
- Ability to calculate different indicators of benefits and threats to use as performance metrics. For example, this may include loss based indicators (emissions), production based indicators (N output, food and energy produced), NUE for different system boundaries, N surplus and other composite indiccators, such as might be used to support other narratives (e.g. sustainable development goals, planetary boundaries etc).

While challenges raised are considerable, the scoping during the INMS Pump-Priming Edinburgh workshop also made clear that experience in model linkage exists, e.g. via modelling teams collaborating within the IPCC process (IPCC, 2014)[27]

INMS partners proposing to contribute to this activity include: ALTERRA (The Netherlands), IIASA, ASU (Lithuania), ILRI (Kenya), RIVM (The Netherlands), INRA (France), IIASA (Austria), PIK (Germany), ALTERRA (The Netherlands), Aarhus University (Denmark), PBL (The Netherlands), TNO (The Netherlands), NERC (UK), JRC (EU).

The following have expressed interest to provide advice and review the work, FAO, WMO, GPNM, CBD, LRTAP.

Task 1.5.1: Translation of storylines & scenarios into defined modelling requirements

Task Output 1.5.1: Proposed approach to implement storylines & scenarios presented for stakeholder feedback

Task Co-Leads: de Vries (WUR) and Winiwarter (IIASA)

There is a clear two-way interaction between the consideration of future scenarios and storylines for the global nitrogen cycle (Activity 2.4) and the requirements for global and regional scale modelling (Activities 1.5 and 2.1). On the one hand there is the capability of current modelling tools, and their immediate future capability following feasible modifications on a certain time horizon. Conversely, there is the call for modelling capability that derives from looking at future scenarios in relation to the present situation. This means that a first task in developing the necessary suite of N models is to consider which fluxes, levels and impacts, and which management options would need to be considered in order to adequately evaluate future scenarios. This need is addressed by the present activity, which will be conducted in cooperation with Activity 2.4. Already from the outset (and based on the INMS Pump Priming Workshop, May 2015, Edinburgh) it has been recognised that the following key points will need to be met:

- Ability to quantify the main environmental threats (Water, Air, Greenhouse balance, Ecosystems, Soils, including both freshwater and marine systems) and benefits for Food, Feed, Fibre and Energy.
- Ability to incorporate the effects of different spatial data related to inputs and emissions, including that related to human population numbers, fertilizer use, combustion emissions, biological nitrogen fixation etc.
- Ability to incorporate the effects of current and emerging management and mitigation technologies, relevant for different N source and emission types (combustion, transport, agriculture, food supply system, food waste etc).

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[27] IPCC (2014) *Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

- Ability to incorporate the effects of changes in human consumption patterns, both in amounts and in choice between major sectors (e.g. livestock based food, plant based food, fish based food, energy use, transport choices).
- Ability to provide data in a form that can be used to link models addressing the costs of taking different actions, or the benefit of actions, and their relationships with adverse effects so as to inform cost-benefit analysis.

The above list provides an ambitious set of eventual goals which it will not be possible to reach immediately. However, they need to be framed so that this task can start the process of working towards this longer term level of integration within Towards INMS.

This activity will be supported by a further workshop funded by the NERC Project INMS Pump Priming, as well as through engagement at INMS plenary meetings. The product will be an INMS working document that summarizes the INMS modelling strategy for the next 3 years. It is anticipated that this strategy should be considered as a living document, and may be reviewed /updated where needed.

Task 1.5.2: Review of component models, criteria, data needs, information flow & outputs

Task Output 1.5.2: Document & database on component models, data, info flow & outputs

Task Co-Leads: de Vries (WUR) and Howard (NERC)

The purpose of this task is to take stock on available nitrogen models for regional and global application, as the starting point for developing further cooperation. This will build on the analysis already started during the PPG phase through the INMS Pump Priming Workshop (Edinburgh, May 2015). The work which has already commenced has identified relevant issues that need to be considered, and identified many available models

Relevant global scale models are related to the links between drivers and pressures, pressures and states and states and impacts as shown below.

Scenario (Driver-pressure) models, allowing Integrated assessments (cost-benefit analysis), including the linkage to emissions

- GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies) model (available for key regions: Europe, South Asia, East Asia, while implemented for all regions globally)
- IMAGE (Integrated Assessment of Global Environmental Change) 3.0 (Global spatially explicit model to assess the consequences of past, current and future demand for energy and food, for emission of GHG and use and emissions of nitrogen and phosphorus).
- Model of Agricultural Production and its Impact on the Environment (MAgPIE).

Pressure-state models (water availability; air, soil and water quality)

- Hydrological models predicting water fluxes/ availability in response to meteorology, being key for the assessment of leaching and runoff of N, such as LPJml, PCR-GLOBWB and WBM.
- Air quality (atmospheric transport) models predicting N air concentrations and N deposition, such as TM5.
- Soil quality models predicting N (NH_3, NO_x, N_2O) emissions and soil N status in response to management and/or air quality changes, such as ForestDNDC, LandscapeDNDC and VSD+.
- Water quality models predicting N (DIN, DON, PN) runoff to rivers and oceans in response to point and diffuse N sources, such as Global NEWS; IMAGE spiralling and RIVE.

State-impact models

- Crop growth models predicting crop growth in response to N inputs and other crop requirements, such as LPJml and WOFOST.
- Earth system models/terrestrial productivity models predicting NPP of terrestrial ecosystems in response to N deposition, ozone exposure, CO_2 and climate, including process based models such as LPJ guess, CLM, OCN and Jules and empirical models, such as EUGROW.
- Human health models, predicting human health due to exposure to ozone and fine particulate matter (PM2.5) being influenced by N emissions, such as ITHIM and DYNAMO-HIA
- Terrestrial biodiversity models predicting plant species diversity/abundance in response to N deposition and other drivers, such as GLOBIO, being part of IMAGE 3.
- Aquatic biodiversity predicting aquatic species diversity/abundance in response to N inputs and other drivers, such as GLOBIO aquatic, part of IMAGE 3.0.

However, more work is needed in this task to bring together atmospheric and marine models together with terrestrial ecosystem, agricultural and catchment models. The information collected will be published as a special report and also combined into an INMS database of nitrogen models, which will be extended as INMS develops.

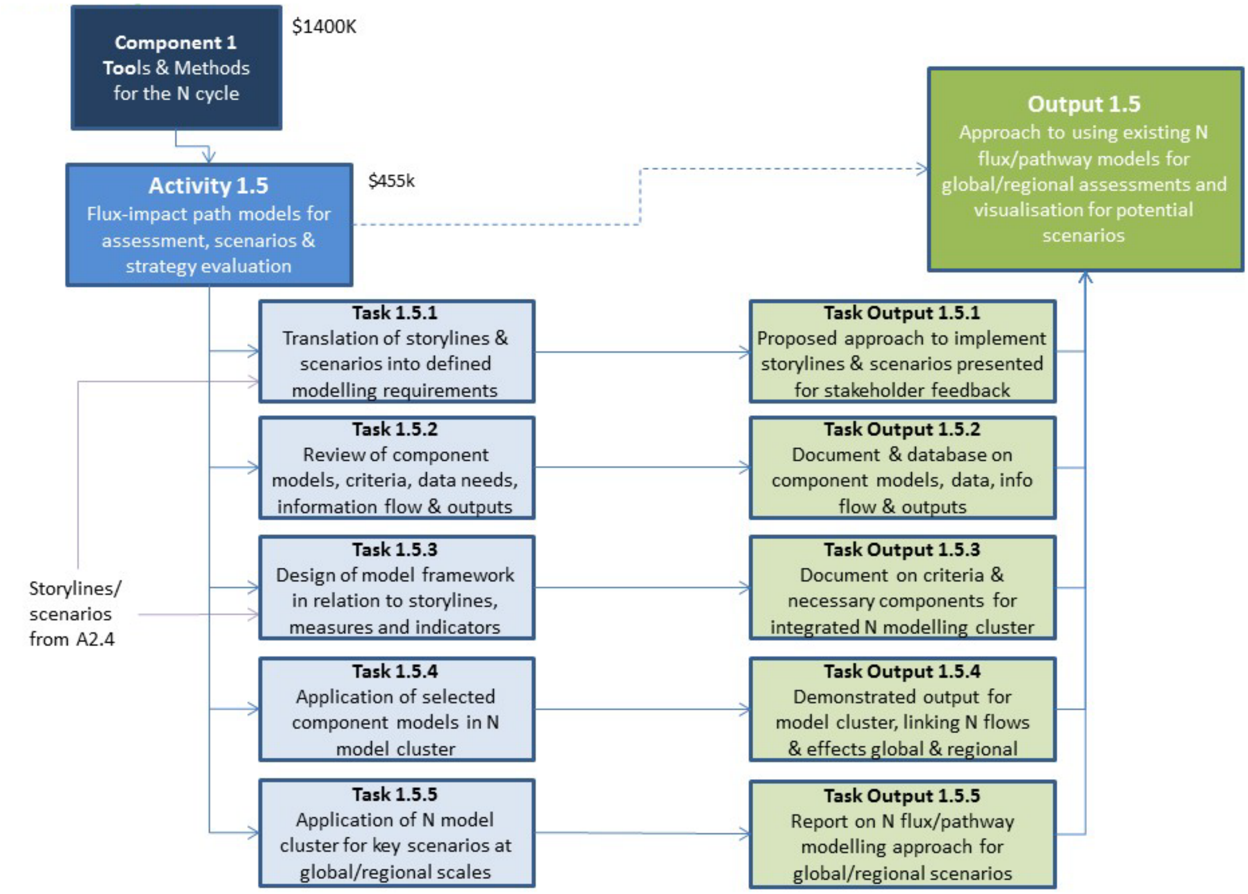

Figure A15.5: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation nitrogen system indicators (Activity 1.5; Output 1.5).*

Task 1.5.3: Design of model framework in relation to storylines, measures and indicators

Task Output 1.5.3: Document on criteria & necessary components for integrated N modelling cluster

Task Co-Leads: de Vries (WUR) and Winiwarter (IIASA)

This task will take the next step in designing a more detailed framework for modelling within INMS. For this purpose it is anticipated for different modellers to work together, identifying both the overarching structure that is needed, but also the potential models that can form components in this structure. In this way the work will aim to show the extent to which different models of partners may be exchangeable within the framework, as well as issues associated with common data needs, and harmonization of output formats, enabling outputs from one set of models to act as inputs to another set of models.

As part of this developing work it is anticipated that specific modelling tasks will be set to allow comparison of performance between models, while at the same time testing how information flow may be achieved between models. The extent to which this is necessary will depend on the number of models being offered into the process. At the same time, the system design will serve to identify key gaps which need investment in INMS or for which capability needs to be developed in future.

The primary output of this task will be a document on criteria & necessary components for integrated N modelling, which will be addressed as a modelling cluster under Activity 1.5.4. At the same time an important outcome of the activity will be a better mutual understanding between different modelling experts that normally work on separate domains (water, air, land etc) as a basis for more fruitful cooperation. In this way, the focused INMS activity is expected to have a catalytic effect on developing this science area.

Task 1.5.4: Application of selected component models in N model cluster

Task Output 1.5.4: Demonstrated output for model cluster, linking N flows & effects global & regional

Task Co-Leads: de Vries (WUR) and Winiwarter (IIASA)

Based on the prior work, this task will focus on demonstrating a model cluster that links together different aspects of the nitrogen cycle to support the overall assessment process. It is anticipated that the first 12-18 months of Towards INMS will focus on improving mutual understanding on the different modelling capabilities in relation to the identified needs (Tasks 1.5.1-1.5.3).

Models that are found to be contributing valuable aspects (also in relation to the indicators developed in Activity 1.1) will be invited to contribute to a model cluster. Model interfaces need to be established based on the proper understanding of respective capabilities. An open competition among INMS partners may be used for this part of the work. Specifically, the model cluster should demonstrate application to model the global nitrogen cycle based on a set of required effects, flows, receptors, management options that need to be included. The list of criteria given above under Task 1.5.1 provides a starting point, which will be used to further refine the priorities by the time of the selection. The cluster demonstration is expected to be developed in years 2-4 of project. The output of this task will be to demonstrate that the model cluster is able to make the links between the main N flows and effects at global and regional scales, especially considering the future change options that have been agreed as essential to address future scenarios (Task 1.5.1; Activity 2.4).

Task 1.5.5: Application of N model cluster for key scenarios at global/regional scales

Task Output 1.5.5: Report on N flux/pathway modelling approach for global/regional scenarios

Task Co-Leads: de Vries (WUR) and Winiwarter (IIASA)

This task allows for finalizing the delivery of the model cluster as a working tool for application in Component 2. It should be emphasized that the focus here in Component 1 is still on model development and testing, and selected cases/scenarios will therefore be identified to primarily for the purpose of testing and evaluating the modelling performance. Where present, case simulations are made, as far as possible comparison will be shown with available measurement-based datasets in order to provide essential verification of the models components. It is expected that in most cases the model cluster will be built from component models that are already existing and to a larger extent tested in relation to measurements. However, new model elements will need special attention for testing as will outcomes which result from new model-chains.

During a meeting of the Modelling Advisory Group to the INMS Pump Priming project (January 2015), it was identified that there are different possible strategies to model integration. The first strategy is to opt for rather simple model connections, such as where the output of one model is used as input into the next model in the chain. The second strategy is to link up models in to a more functional whole, which can have the advantage of allowing feedbacks to be addressed more explicitly. The Modelling Advisory Group agreed that the priority within INMS must be for the first of these approaches, although a small fraction of resources may be reserved for the second approach. This conclusion was based on the need to ensure that INMS delivers usable products within the time-frame available. It is considered that more ambitious model linking approaches may be seen as a higher priority at a later stage. For example, the first operative model cluster may drive the priority for more advanced approaches. More advanced coupling approaches may also be better suited to allied activities linking to additional INMS co-financing, thereby seeding possible future developments.

The output of this task will therefore be results from the application of the INMS model cluster for a selection of cases, with an emphasis on demonstrating model performance and readiness for further application and scenario analysis in Component 2 (especially Activities 2.1 and 2.4, while considering the priority needs identified in Activity 2.3).

2.4.6 Activity 1.6: Examination of the barriers achieving to better nitrogen management

Output 1.6 Understanding the barriers to change at all levels of society (government, private sector and civil society) including technical, financial and socio-political limitations.

Activity Co-Leads: INI Europe (Garnett, Oxford Martin School) and INI Africa (Masso, IITA)

The preceding tasks provide the necessary models, tools and indicators for examining options for better management of the global nitrogen cycle, however only marginally address the social, economic and cultural issues. In this regard the cost-benefit analysis (Activity 1.4) is an important contribution, especially if the conclusion is that taking actions to improve nitrogen management can be shown to have net benefits for society (the benefits of action exceeding the costs). This has already been the conclusion of previous work, such as Our Nutrient World, which concluded that the value of N saved by reducing losses would typically be larger than the cost to business of saving it, for example in farming systems, and that the benefits in terms of cleaner air, water etc are even larger.

In this case, the question is therefore raised: if the benefits of improved nitrogen management outweigh the costs, what are the barriers that are preventing change? This activity is focused on addressing this question, which then leads towards consideration of the options that can help overcome the barriers. Such barriers may be related to lack of awareness, dominant priorities for regional food and energy sufficiency and economic growth, the need to kick-start new markets, trade-related issues or over-dominance of an existing paradigm of a lack of integration, with the result that the full-scale extent of the win-wins is not appreciated. The present activity therefore tests one of the hypotheses of INMS that a joined up approach to nitrogen management will more clearly profile the multiple win-wins to taking action (for food, energy, water, air, climate, ecosytems, soils etc).

The Activity is structured as four tasks. Firstly a scoping study considers the range of potential barriers, in relation to all major N flows and differences in regional soci-economic development. This part therefore includes all major reactive N sources: agricultural fertilizers, biological nitrogen fixation, nitrogen oxides formation in combustion sources, as well as recycling opportunities including manures and human waste flows. The second and third tasks focus on special challenges, linked to the food system and to human consumption choices, respectively, especially as these link to behavioural change among farmers, land managers and citizens. Finally, the last task explores the options for overcoming barriers to change, including the potential for developing 'the gravity of common cause' though the full nitrogen approach.

INMS partners proposing to contribute to this activity include: IITA (Kenya), Oxford Martin School (UK), VU (The Netherlands), IIASA, PCH (Spain), WRI, ZJU (China), PBL (The Netherlands), BBRI (Bangladesh), NANC (USA), ISA, NERC (UK).

The following have expressed interest to provide advice and review the work: INRA (France), ADEME (France), RIVM (The Netherlands), ASU (Lithuania), FAO-AGA, ATB (Germany), CARR (China), IFA, Fertilizers Europe (Europe), GPNM, CBD, LRTAP.

Task 1.6.1: Examination of economic, cultural & other factors that affect adoption of measures in the nitrogen cycle.

Task Output 1.6.1: Report on the economic & cultural factors helping/ hindering adoption of options for better nitrogen management

Task Co-Leads: Garnett (Oxford Martin School) and Masso (IITA)

This task represents a first scoping assessment on the barriers to change that prevent better nitrogen management. A broad approach will be taken inviting stakeholder contributions through special sessions linked to the main INMS meetings. The starting point will be to consider each of the main N sources (fertilizer, biological nitrogen fixation, combustion) and resources for better N recycling (manure, solid waste, sewage) and summarize the main actions that are recommended for their better management. The Ten Key Actions identified as options in Our Nutrient World will provide a starting point to address what are the barriers to each of these actions. As the barriers are likely (at least to some extent) to differ regionally, this discussion will be informed by engagement with contrasting examples from the INMS Demonstration Regions. As a first activity at the start of the project, it must be recognized that the INMS regional demonstrations will themselves only be starting. Therefore the focus will be to draw especially on existing experiences in these regions. A more detailed examination in relation to the INMS regional demonstrations will be made later in the project in connection with Task 1.6.4.

The examination will not only consider barriers, but also consider the factors that promote adoption, drawing on case studies representing success stories. For the purpose of this initial review, such success stories may not necessarily only concern nitrogen; examples from other fields which can be applied to the nitrogen case may also be useful.

The outcome will be a scoping report delivered as a working INMS paper, which may stimulate discussion and feedback to the team from the wider INMS community and other stakeholders. Following feedback and amendments it is anticipated to publish this report as an external INMS report, which may also be submitted for journal publication.

Task 1.6.2: Global/regional examination of N barriers to change in food systems

Task Output 1.6.2: Report on global/regional barriers to better N management in the food system

Task Co-Leads: Gu (Zhejiang Univesity) and Masso (IITA)

This task focuses especially on examining the barriers to better nitrogen management in the food system. Nitrogen management in the food system is here conceived as including agricultural N inputs (fertilizers, biological nitrogen fixation, atmospheric deposition), growing of food and feed crops and of crops for bioenergy, livestock production, product storage and distribution. Issues related to consumer choice regarding diet and food waste are a key part of the food system, and are therefore addressed specifically under Task 1.6.3.

One of the barriers that is often mentioned in relation to improving agricultural nitrogen management is the fear that best practices (from a pollution perspective) may increase costs making farmers less competitive in global markets. Specific attention will be given to examine this challenge and to explore options that may help address it. This will include engagement across different parts of the food system, including with suppliers, farmers, food processors, distributors and sales.

To make progress with the available resources in this task it is anticipated to start by contrasting example situations selected from the INMS regions (e.g. developed vs developing region). It is expected that this will then then stimulate discussion with the other regional demonstration areas. This activity will be stimulated by specific discussion during a special session of the INMS plenary meetings to encourage feedback and engagement from the other demonstration regions.

The work will lead towards the development of an INMS report on the global-regional barriers and opportunities to better nitrogen management. As with other INMS reports, it is expected that a draft would be presented to the INMS plenary for amendment and adoption, allowing subsequent publication as an agreed product. It is expected that the report will also be suitable for submission as a peer review paper.

Task 1.6.3: Global/regional examination of N barriers to change in consumption-production

Task Output 1.6.3: Report on N barriers for global/ regional consumption-production

Task Co-Leads: Westhoek (PBL) and Garnett (Oxford Martin School)

Several recent studies have shown the importance of food choice in the amount of pollution that is associated with given levels of production. This is a topic that illustrates the importance of citizen's choices and the potential power of behavioural change. Examples include the link between transport choices and nitrogen oxides emissions and between dietary choices and nitrogen pollution. For example, the ENA Special Report 'Nitrogen on the Table' has recently shown that halving meat and dairy intake in Europe would reduce levels of nitrogen pollution by around 40%, while freeing up large areas of agricultural land to exploit other opportunities (e.g. bioenergy production, increasing grain export).[28] At the same time in this scenario European citizens would still be consuming more protein than needed for a healthy diet.

This example illustrates how behavioural change is critical to nitrogen pollution from both combustion sources and food related sources. While this task will consider both aspects, most attention will be given to the latter given that this has received less attention in other areas. The analysis will consider the extent to which linkage between issues may help overcome barriers to change (e.g. food costs to consumers, health benefits, environmental benefits). At the same time, it will be vital to consider the implications for business sectors and how farming activities might respond to such a transition. Here it will be relevant to explore narratives that could provide simultaneous benefits to farmers and consumers. This may consider the potential for high quality - low volume strategies to maintain farmer profits, for novel agricultural products to provide new markets, and the potential for bioenergy markets to further develop in a way that is financially attractive for farmers.

A key part of the examination must be the interaction between regional and global scales. It is clear that Western patterns of consumption are currently unsustainable, and are becoming even more unsustainable as the rapidly developing economies seek to further adopt western lifestyles with high meat, energy and transport consumption. The potential for interactions between regions will to be considered, especially in developing future aspirations for citizens in the future. Such future aspirations need to be considered also in the light of possible transformations of future food production (e.g. potential growing market for low-cost laboratory tissue-cultured meat in future).

While this work will look at these issues as they connect across the nitrogen cycle, it will necessarily draw on other international activities related to sustainable production and consumption, including by UNEP and others. The outcome will be a specific report, again to be presented to the INMS plenary for adoption and publication, which can also lead to a peer review paper.

[28] Westhoek H. et al. (2015) *Nitrogen on the Table: The influence of food choices on nitrogen emissions and the European environment.* (European Nitrogen Assessment Special Report on Nitrogen & Food.)

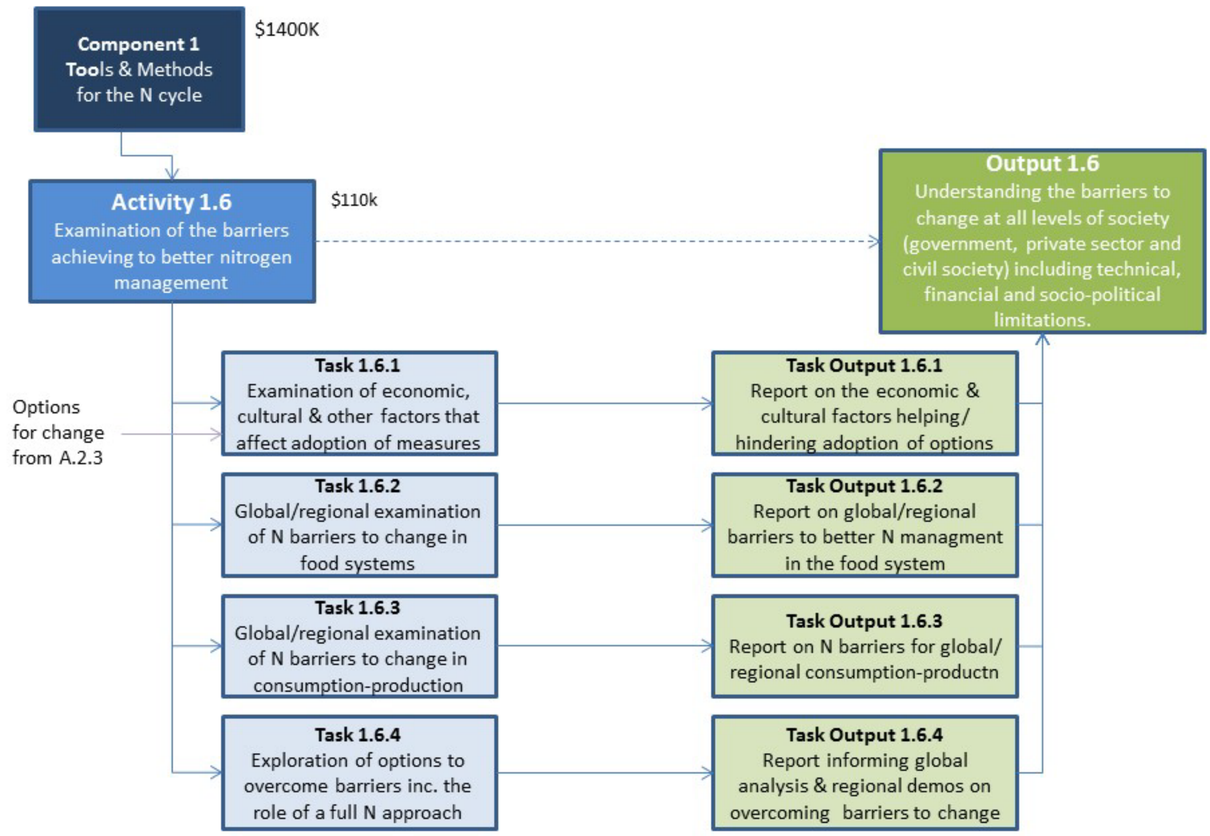

Figure A15.6: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation nitrogen system indicators (Activity 1.6; Output 1.6).*

Task 1.6.4: Exploration of options to overcome barriers inc. the role of a full N approach

Task Output 1.6.4: Report informing global analysis & regional demos on overcoming barriers to change

Task Co-Leads: Masso (IITA) and Garnett (Oxford Martin School)

This task will synthesize the different issues raised in relation to barriers to change. Coming towards the end of the project, it will draw on experiences from the regional demonstrations, and help reflect on the achievability of different global scenarios (Activity 2.4). It is anticipated that the report will be useful for finalizing outcomes from the regional demonstrations and for sharing lessons learned between the regions. In addition, the report is expected to incorporate key findings from other parts of this activity as a contribution to the global assessment process (Activity 2.3).

2.5 Budget

2.5.1 GEF Budget

The overall budget for Component 1 is summarized in Table 2 below according to the standard UNEP cost codes. This is followed by a detailed breakdown of costs by year for each of the Activities 1.1 to 1.6. An additional activity is identified that allows for technical inputs at the level of Component 1 as a whole to ensure integration.

Code	Heading	Component 1 A1.1 N system indicators	A1.2 Threat assessnt methods	A1.3 N fluxes & distrib methods	A1.4 Threat-benefit valuation	A1.5 Flux impact models	A1.6 Barriers to better N managnt	A1.0 Comp level coord	Total C1
1161	Staff & other personnel	20	20	20	15	35	10	10	130
1561	Travel	40	32	32	10	30	10	0	154
2161	Contractual services	0	0	0	0	0	0	0	0
2261	Grants to implementing partners	160	130	130	93	390	88	105	1096
4161	Materials & Supplies	10	3	3	2	0	2	0	20
4261	Non-expendable equipment	0	0	0	0	0	0	0	0
5161	Other Direct Operating costs	0	0	0	0	0	0	0	0
5581	Evaluation (consultant fees etc)	0	0	0	0	0	0	0	0
	Total	**230**	**185**	**185**	**120**	**455**	**110**	**115**	**1400**

Table A15.2: *Budget overview for Component 1: Tools and Methods for the Nitrogen Cycle (totals by Activity). Values in US $100K.*

Cost Code	Cost Heading	Activity 1.1 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	N indicators support	5	5	5	5	20
1561	Travel	Travel for N indicators	10	10	10	10	40
2161	Contractual services	na					0
2261	Grants to implementing partners	Nat N budgets devlpt (TO 1.1.1)	10	10	10	10	40
		Farm N budgets devlpt (TO 1.1.2)	25	25	0	0	50
		NUE workshop (TO 1.1.3)	0	40	0	0	40
		Relating N effects & NUE indicators (TO 1.1.4)	0	0	30	0	30
4161	Materials & Supplies	Materials and consumables	3	2	2	3	10
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**53**	**92**	**57**	**28**	**230**

Table A15.3: *Budget for Activity 1.1 Development of Nitrogen System Indicators (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 1.2 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Threat assessment support	5	5	5	5	20
1561	Travel	Travel for threat assessment	5	17	8	2	32
2161	Contractual services	na					0
2261	Grants to implementing partners	Preparation identification key threats (TO 1.2.1)	20				20
		Preparation stakeholder review (TO 1.2.2)	10	20			30
		Threat methodology workshop (TO 1.2.3)		50			50
		Drafting threat assessment guidance (TO 1.2.4)			30		30
4161	Materials & Supplies	Materials and consumables	1	1	1	0	3
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**41**	**93**	**44**	**7**	**185**

Table A15.4: *Budget for Activity 1.2 Development of Threat Assessment Methodology (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 1.3 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	N flux & distribution support	5	5	5	5	20
1561	Travel	Travel for N flux & distribution work	5	8	17	2	32
2161	Contractual services	na					0
2261	Grants to implementing partners	Scoping N flux & distrn methods (TO 1.3.1)	20				20
		Review N flux & distrn methods (TO 1.3.2)		30			30
		Workshop on N flux & distrn methods (TO 1.3.3)		10	40		50
		Prepartion of N flux & distrn guidance (TO 1.3.4)			20	10	30
4161	Materials & Supplies	Materials and consumables		1	1	1	3
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**30**	**54**	**83**	**18**	**185**

Table A15.5: *Budget for Activity 1.3 Development of Methodology for Nitrogen Fluxes and Distribution (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 1.4 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	N cost benefit development	3	4	4	4	15
1561	Travel	Travel for cost-benefit development	1	6	3	0	10
2161	Contractual services	na					0
2261	Grants to implementing partners	Review existing CBA studies (TO 1.4.1)	15				15
		Refine CBA for contrasting economies (TO 1.4.2)		25			25
		Integrate WAGES FE into CBA (TO 1.4.3).			28		28
		Valuation C&B under future N scenarios (TO 1.4.4)			10	15	25
4161	Materials & Supplies	Materials and consumables	0	1	1	0	2
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**19**	**36**	**46**	**19**	**120**

Table A15.6: *Budget for Activity 1.4 Development of Approaches for Nitrogen Threat-Benefit Valuation (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 1.5 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Flux impact path model support	10	10	10	5	35
1561	Travel	Travel for flux impact path models	15	10	3	2	30
2161	Contractual services	na					0
2261	Grants to implementing partners	Trans storylines to modelling reqtnts (TO 1.5.1)	30				30
		Review component models & database (TO 1.5.2)	60				60
		Design model framework & criteria doc (TO 1.5.3)	10	60			70
		Demonstration of model cluster (TO 1.5.4)		60	120		180
		Applic. of cluster for e.g. scenarios (TO 1.5.5)			50		50
4161	Materials & Supplies	Materials and consumables					0
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**125**	**140**	**183**	**7**	**455**

Table A15.7: *Budget for Activity 1.5 Flux-impact path models for assessment, scenarios & strategy evaluation (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 1.6 / Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Support on barriers to better N mangnt	2	3	3	2	10
1561	Travel	Travel for barrriers to better N managnt	2	6	1	1	10
2161	Contractual services	na					0
2261	Grants to implementing partners	Examination of cultural & econ barriers (TO 1.6.1)	10				10
		Examine barriers in food systems (TO 1.6.2)		10	20		30
		Examine barriers in consumptn/prodn (TO 1.6.3)		10	20		30
		Explore options to overcome barriers (TO 1.6.4)			10	8	18
4161	Materials & Supplies	Materials and consumables	0	1	1	0	2
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**14**	**30**	**55**	**11**	**110**

Table A15.8: *Budget for Activity 1.6 Examination of the barriers achieving to better nitrogen management (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 1 / Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Support for Component 1 science direction	3	3	2	2	**10**
1561	Travel	Travel at component level					0
2161	Contractual services	na					0
2261	Grants to implementing partners	Component Leadership Tools & Methods (C1)	28	30	30	17	105
							0
							0
							0
4161	Materials & Supplies	Materials and consumables					0
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**31**	**33**	**32**	**19**	**115**

Table A15.9: *Budget for Activity 1.0 Component Leadership: Tools & Methods (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Component 1 by year / Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Technical support to the activities	33	35	34	28	130
1561	Travel	Travel at component level	38	57	42	17	154
2161	Contractual services	na					0
2261	Grants to implementing partners	Total of grants to partners	238	380	418	60	1096
4161	Materials & Supplies	Materials and consumables	4	6	6	4	20
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**313**	**478**	**500**	**109**	**1400**

Table A15.10: *Budget overview for Component 1: Tools and Methods for the Nitrogen Cycle (costs by year). Values in US $100K.*

2.5.2 Co-financing (Values in US $)

Partner involvement	Sources of co-financing	Type	Partner name/Name of co-financier	Organisation short name	Country or International	Cash or in-kind co-financing	Total for Component 1
			Partners primarily with global focus in the project				
C1	GEF Agency	Policy support	United Nations Environment Programme	UNEP	Kenya	Cash co-financing	-
						In-kind co-financing	160,000
						Total Co-financing	**160,000**
C2	Non-ministry government body	Science and Policy Support	Natural Environment Research Council	NERC	UK	Cash co-financing	302,698
						In-kind co-financing	1,612,565
						Total Co-financing	**1,915,264**
C3	Others	Science and Policy Support	University of Edinburgh	UED	UK	Cash co-financing	-
						In-kind co-financing	2,142,412
						Total Co-financing	**2,142,412**
D1	Other Multilateral Agency (ies)	Science	Secretariat to the Convention on Biological Diversity	CBD	Canada	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
D2	Other Multilateral Agency (ies)	Policy support	UNECE Conventions on Transboundary Water and Transboundary Air Pollution	UNECE	Switzerland	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D3	Other Multilateral Agency (ies)	Policy support	Organisation for Economic Co-operation and development	OECD	France	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D4	Other Multilateral Agency (ies)	Science and Policy Support	Food and Agriculture Organization of United Nation	FAO - AGA	International	Cash co-financing	-
						In-kind co-financing	226,000
						Total Co-financing	**226,000**
D5	Other Multilateral Agency (ies)	Science	World Meteorological Organisation	WMO	Switzerland	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D6	Other Multilateral Agency (ies)	Science and Policy Support	International Institute for Applied Systems Analysis	IIASA	Austria	Cash co-financing	-
						In-kind co-financing	920,000
						Total Co-financing	**920,000**
D7	Other Multilateral Agency (ies)	Science and Policy Support	European Commissions, Joint Research Centre	JRC	International	Cash co-financing	-
						In-kind co-financing	690,000
						Total Co-financing	**690,000**
D8	Other Multilateral Agency (ies)	Science and Practices	The Interna tional Maize and Wheat Improvement Center	CIMMYT	Mexico	Cash co-financing	-
						In-kind co-financing	250,000
						Total Co-financing	**250,000**
D9	Non-ministry government body	Science and Policy Support	PBL Netherlands Environmental Assessment Agency	PBL	The Netherlands	Cash co-financing	-
						In-kind co-financing	100,000
						Total Co-financing	**100,000**
D10	Non-ministry government body	Science	National Institute for Public Health and the Environment The Netherlands	RIVM	The Netherlands	Cash co-financing	-
						In-kind co-financing	180,000
						Total Co-financing	**180,000**
D11	Non-ministry government body	Science and Policy Support	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	ENEA	Italy	Cash co-financing	160,000
						In-kind co-financing	535,000
						Total Co-financing	**695,000**
D12	Non-ministry government body	Science and Practices	National Institute for Agronomic Research	INRA	France	Cash co-financing	-
						In-kind co-financing	320,000
						Total Co-financing	**320,000**
D13	Ministry government body	Science and Policy Support	United States Environmental Protection Agency	EPA	USA	Cash co-financing	-
						In-kind co-financing	380,000
						Total Co-financing	**380,000**
D14	Non-ministry government body	Science and Policy Support	Federal Environment Agency	UBA	Germany	Cash co-financing	-
						In-kind co-financing	1,146,906
						Total Co-financing	**1,146,906**
D15	Non-ministry government body	Science and Policy Support	French Agency for Environment and Energy Management	ADEME	France	Cash co-financing	-
						In-kind co-financing	1,800
						Total Co-financing	**1,800**
D16	Non-ministry government body	Science	Consiglio Nazionale delle Ricerche	CNR	Italy	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D17	Non-ministry government body	Science	Norwegian Meteorological Institute	MET Norway	Norway	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D18	Non-ministry government body	Science and Practices	Victorian Department of Economic Development, Jobs, Transport and Resources - Agriculture Division	DEDJTR	Australia	Cash co-financing	200,000
						In-kind co-financing	300,000
						Total Co-financing	**500,000**
D19	Others	Science and Policy Support	Alterra Wageningen University and Research Centre	ALTERRA	The Netherlands	Cash co-financing	1,916,852
						In-kind co-financing	1,506,900
						Total Co-financing	**3,423,752**
D20	Others	Science and Policy Support	Wageningen University and Research Centre, Livestock Research	WUR LR	The Netherlands	Cash co-financing	2,725,250
						In-kind co-financing	426,250
						Total Co-financing	**3,151,500**

D21	Others	Science and Policy Support	Energy research Centre of the Netherlands	ECN	The Netherlands	Cash co-financing	-
						In-kind co-financing	235,750
						Total Co-financing	**235,750**
D22	Others	Science and Policy Support	Vrije Universiteit	VU	The Netherlands	Cash co-financing	-
						In-kind co-financing	100,000
						Total Co-financing	**100,000**
D23	Others	Science and Practices	Nederlandse organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek	TNO	The Netherlands	Cash co-financing	-
						In-kind co-financing	600,000
						Total Co-financing	**600,000**
D24	Others	Science and Policy Support	Potsdam Institute for Climate Impact Research	PIK	Germany	Cash co-financing	-
						In-kind co-financing	474,066
						Total Co-financing	**474,066**
D25	Others	Science	University of Bonn	UBO	Germany	Cash co-financing	-
						In-kind co-financing	330,000
						Total Co-financing	**330,000**
D26	Others	Science and Practices	Leibniz Institute for Agricultural Engineering	ATB	Germany	Cash co-financing	-
						In-kind co-financing	6,000
						Total Co-financing	**6,000**
D27	Others	Science and Practices	Aarhus University, Department of Bioscience	AU Bios	Denmark	Cash co-financing	-
						In-kind co-financing	175,000
						Total Co-financing	**175,000**
D28	Others	Science and Practices	Aarhus University, Department of Agroecology	AU Agro	Demark	Cash co-financing	200,000
						In-kind co-financing	400,000
						Total Co-financing	**600,000**
D29	Others	Science and Practices	Aarhus University, Department of Environmental Science	AU, Envs	Denmark	Cash co-financing	-
						In-kind co-financing	190,000
						Total Co-financing	**190,000**
D30	Others	Science and Practices	Institute of Water Resources Engineering	ASU	Lithuania	Cash co-financing	-
						In-kind co-financing	3,800
						Total Co-financing	**3,800**
D31	Others	Science and Practices	Agrophysical Research Institute	ARI	Russian Federation	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D32	Others	Science Support	Institute of Physicochemical and Biological Problems in Soil Science	IPBPSS	Russian Federation	Cash co-financing	10,000
						In-kind co-financing	20,000
						Total Co-financing	**30,000**
D33	Others	Science and Practices	Instituto Superior de Agronomia (School of Agronomy) of the University of Lisbon	ISA	Portugal	Cash co-financing	-
						In-kind co-financing	99,000
						Total Co-financing	**99,000**
D34	Others	Science and Practices	Ataturk Horticultural Central Research Institute	ABKAE	Turkey	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D35	Others	Science and Practices	Fundacao da Faculdade de Ciencias da Universidade de Lisboa, FP	FFCUL	Portugal	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D36	Others	Policy support and Practices	Stockholm Environment Institute at York / York University	SEI York	UK	Cash co-financing	5,072
						In-kind co-financing	1,791,049
						Total Co-financing	**1,796,121**
D37	Others	Science and Practices	University of East Anglia	UEA	UK	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D38	Others	Science, Practice and Policy Support	North American Nitrogen Center	NANC	USA	Cash co-financing	-
						In-kind co-financing	580,000
						Total Co-financing	**580,000**
D39	Others	Science and Policy Support	New York University	NYU	USA	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D40	Others	Science and Practices	World Resources Institute	WRI	International	Cash co-financing	-
						In-kind co-financing	200,000
						Total Co-financing	**200,000**
D41	Others	Science and Practices	University of Missouri	MU	USA	Cash co-financing	133,000
						In-kind co-financing	295,000
						Total Co-financing	**428,000**
D42	Others	Science and Practices	AgReseach Limited	AgResearch	New Zeland	Cash co-financing	100,000
						In-kind co-financing	450,000
						Total Co-financing	**550,000**
B1	Private Sector/Business	Policy Interest and Practices	Fertilizers Europe	Fertilizers Europe	Belgium	Cash co-financing	88,300
						In-kind co-financing	36,500
						Total Co-financing	**124,800**
B2	Private Sector/Business	Science and Practices	Centre for Plant Nutrition Hanninghof, Yara GmbH & Co.KG, Germany	YARA	International	Cash co-financing	-
						In-kind co-financing	30,000
						Total Co-financing	**30,000**
B3	Private Sector/Business	Science and Practices	Badische Anilin und Soda Fabrik	BASF	Germany	Cash co-financing	-
						In-kind co-financing	30,000
						Total Co-financing	**30,000**

B4	Private Sector/Business	Science and Practices	SKW Stickstoffwerke Piesteritz GmbH	SKWP	Germany	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
B5	Private Sector/Business	Science, Policy and Practices	PigCHAMP Pro Europa S.L.	PCH	Spain	Cash co-financing	-
						In-kind co-financing	**100,000**
						Total Co-financing	**100,000**
B6	Private Sector/Business	Policy Interest and Practices	International Fertilizer Industry Association	IFA	France	Cash co-financing	-
						In-kind co-financing	**20,000**
						Total Co-financing	**20,000**
B7	Private Sector/Business	Science and Policy Interest	International Plant Nutrition Institute	IPNI	United States	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
B8	Private Sector/Business	Practices Development	European Agricultural Machinery	CEMA	Belgium	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
S1	Civil Society Organisation	Policy and Dissemination	Non-governmental organization New Energy	NGO "New Energy"	Ukraine	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
S2	Civil Society Organisation	Policy and Dissemination	World Wide Fund for Nature conservation	WWF	UK	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
S3	Civil Society Organisation	Policy and Dissemination	Planetary Boundary Initiative	PBI	UK	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
			Partners primarily with regional demonstration focus in the project				
			CASE 1: Developing regions with excess reactive nitrogen				
R1	Others	Science and Practices	Institute of Soil Science, Chinese Academy of Sciences	ISSCAS	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R2	Others	Science and Practices	National Institute for Agro-Environmental Sciences	NIAES	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R3	Others	Science, Practice and Policy Support	China Agricultural University	CAU - Crop	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R4	Others	Science and Practices	China Agricultural University	CAU - Soil	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R5	Others	Science and Support	Beijing Forestry University	BFU	China	Cash co-financing	-
						In-kind co-financing	**160,000**
						Total Co-financing	**160,000**
R6	Others	Science and Practices	Zhejiang University	ZJU	China	Cash co-financing	-
						In-kind co-financing	**200,000**
						Total Co-financing	**200,000**
R7	Others	Science and Practices	Chinese Academy of Science, Center for Agricultural Resources Research, Institute of Genetic and Developmental	CARR	China	Cash co-financing	**40,000**
						In-kind co-financing	**120,000**
						Total Co-financing	**160,000**
R8	Others	Science and Practices	Field Science Center for Northern Biosphere, Hokkaido University	FSCNB-HU	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R9	Others	Science and Practices	Research Faculty of Agriculture, Hokkaido University	Ag-HU	Japan	Cash co-financing	-
						In-kind co-financing	**10,000**
						Total Co-financing	**10,000**
R10	Others	Science and Practices	National Institute for Environmental Studies	NIES	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R11	Others	Science and Practices	Kyoto University	KU	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R12	Multilateral Agency	Policy Support	Partnerships in Environmental Management for the Seas of East Asia	PEMSEA	Philippines	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R13	Others	Science and Practices	Rothamsted Research	RRes	UK	Cash co-financing	**120,000**
						In-kind co-financing	**250,000**
						Total Co-financing	**370,000**
R14	Others	Science and Dissemination	Society for Conservation of Nature	SCON	National	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R15	Others	Science and Practices	BBRI Bangladesh	BRRI	Bangladesh (National)	Cash co-financing	-
						In-kind co-financing	**135,000**
						Total Co-financing	**135,000**
R16	Others	Science and Practices	CSIR-National Environmental Engineering Research Institute	NEERI	India	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R17	Multilateral Agency	Policy Support	South Asia Co-operative Environment Programme	SACEP	Sri Lanka	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R18	Others	Science Practices and Policy Support	Earth System Science Centre/National Institute For Space Research	CCST-INPE	Brazil	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-

			CASE 2: Developing regions with insufficient reactive nitrogen				
R19	Multiulateral Agency	Science and Practices	International Institute of Tropical Agriculture	IITA	International (Africa)	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R20	Multiulateral Agency	Sciense Support	Livestock Systems and Environment International Livestock Research Institute	ILRI	Kenya	Cash co-financing	-
						In-kind co-financing	**150,000**
						Total Co-financing	**150,000**
R21	Multiulateral Agency	Practice and Policy Support	Lake Victoria Commission Secretariat	LVBC	Uganda	Cash co-financing	**9,000**
						In-kind co-financing	**60,000**
						Total Co-financing	**69,000**
R22	Others	Science and Practices	Karlsruhe Institute of Technology	IMK-IFU	Germany	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R23	Others	Science and Practices	Ghent University	UGENT	Belgium	Cash co-financing	-
						In-kind co-financing	**100,000**
						Total Co-financing	**100,000**
R24	Others	Science and Practices	Laboratoire d'Aérologie Observatoire Midi-Pyrénées	LA UMR 5560	France	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
			CASE 3: Nitrogen challenges for transition economies				
R25	Others	Science and Practices	Odessa National I. I. Mechnikov University	ONU	Ukraine	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R26	Others	Science and Practices	Institute of agroecology and environmental management of National Academy of Agrarian Sciences	IAEM	Ukraine	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R27	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution "Institute for Engineering and Environmental Problems in Agricultural	IEEP	Russian Federation	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R28	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution "All-Russian Scientific Research Institute for Organic	VNIIOU	Russia	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R29	Others	Science Support	Scientific Research Institute for Atmospheric Air Protection	SRI	Russian Federation	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R30	Multilateral Agency	Policy and Practices Support	Commission on the Protection of the Black Sea Against Pollution	BSC PS	Turkey	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
			CASE 4: Nitrogen challenges for developed regions with excess reactive nitrogen [without GEF resources]				
R31	Others	Science and Practices	University Pierre and Marie Curie	UPMC	France	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R32	Others	Science and Practices	Technical University of Madrid	UPM	Spain	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R33	Others	Science Practices and Policy Support	Centro de Investigaciones Energéticas Medioambientales y Tecnológicas	CIEMAT	Spain	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
						Cash co-financing	$6,010,172
						In-kind co-financing	$18,248,998
						Total	**$24,259,170**

2.6 Component work-plan and timeline

2.6.1 Timeline

Component 1 operates throughout the duration of the project. Initial scoping and methodological aspects are focused in Year 1, providing the basis to develop the methodologies in Year 2 and Year 3. Year 4 focuses primarily on application of the methods developed and in developing synergies with Components 2, 3 and 4. The activity workplans show the detailed timing.

2.6.2 Activity Workplans

The following nomenclature is used on the diagrams below:

M = Meeting, **R**= Report (includes other publications), **W** = Workshop

Activity 1.1: Development of N System indicators	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 1.1.1 **Development of National N budget approaches**		M				M				M		R		M		
Task 1.1.2 **Development of Farm N budgets**		M				M				M		R				
Task 1.1.3 **Development of NUE approaches**		M			R	M				M R						
Task 1.1.4 **Relating of Level & Effect Indicators to budget indicators**		M	R							M				M R		
Monitoring and Evaluation					R				R				R			R

Activity 1.2 Development of threat assessment methodology	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 1.2.1 **Initial identification of Key Nitrogen Threats**		R														
Task 1.2.2 **Conduct stakeholder review & refine N key threats & criteria**				R												
Task 1.2.3 **Workshop(s) to review assessment methodologies for different N threats**								W								
Task 1.2.4 **Drafting guidance on overall N threat assessment methodology**												R				
Monitoring and Evaluation					R				R				R			

Activity 1.3 Development of methodology for N fluxes and distribution	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 1.3.1 Scoping of N flux and distribution methods (air, land, water, marine, trade)			R													
Task 1.3.2 Conduct reviews of N flux and distribution methods for environ. compartments							R									
Task 1.3.3 Workshop on harmonizing methodologies for key N fluxes and distribution									W							
Task 1.3.4 Preparing guidance on N flux & distribution methods, plus international support													R			
Monitoring and Evaluation					R				R				R			R

Activity 1.4 Development of approaches for N threat-benefit valuation	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 1.4.1 Review of existing threat benefit valuation studies			R													
Task 1.4.2 Refinement of threat benefit valuation across contrasting economies						R										
Task 1.4.3 Integration of food, health, ecosystem, climate & energy benefits & threats						M			R							
Task 1.4.4 Valuation of threats & benefits under future nitrogen scenarios														R		
Monitoring and Evaluation					R				R				R			R

Activity 1.5 Flux-impact path models for assessment, scenarios & strategy evaluation	Year 1	Year 2	Year 3	Year 4

	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 1.5.1 **Translation of storylines & scenarios into defined modelling requirements**		R														
Task 1.5.2 **Review of component models, criteria, data needs, information flow & outputs**				R												
Task 1.5.3 **Design of model framework in relation to storylines, measures and indicators**				W				R								
Task 1.5.4 **Application of selected component models in N model cluster**								M				R				
Task 1.5.5 **Demonstration of N model cluster for key scenarios at global/regional scales**												M				
Monitoring and Evaluation					R				R				R			

Activity 1.6 **Examination of the barriers achieving to better nitrogen management**	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 1.6.1 **Examination of economic, cultural & other factors that affect adoption of measures**		M	R													
Task 1.6.2 **Global/regional examination of N barriers to change in food systems**						M					R					
Task 1.6.3 **Global/regional examination of N barriers to change in consumption-production**						M					R					
Task 1.6.4 **Exploration of options to overcome barriers, including the role of a full N approach**											M				R	
Monitoring and Evaluation					R				R				R			R

2.7 Execution arrangements

The involvement of partners in each component and activity is based on their expressed commitments to the project. Leadership of Components and Activities will be confirmed by the Project Partners Assembly or amended at the start of the project. Figure A15.7 shows the provisional organogram used to prepare the project, subject to this confirmation.

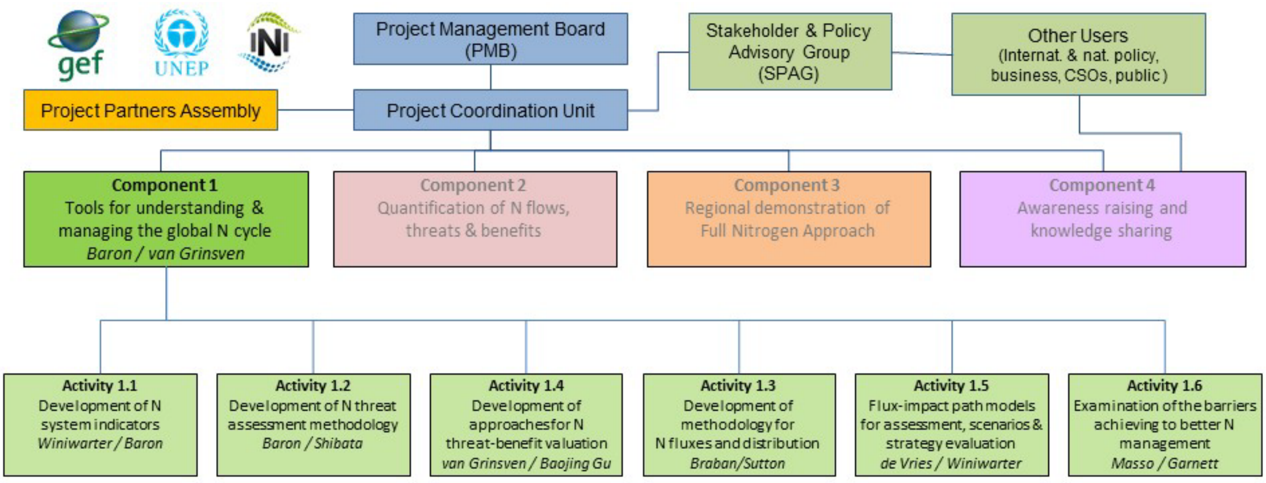

Figure A15.7: *Organogram of Component 1.*

2.8 Component M&E

The day-to-day monitoring of the activities of Component 1 of 'Towards INMS' will be conducted by the Component Leaders and communicated regularly to the PCU (and through the Component Leaders' presence in the PMB). This will enable the PCU to report to UNEP, in addition to the internal needs of progress reporting to the Project Management Board and Project Partners Assembly. The Task and Activity Leaders will also be responsible for providing regular reports on progress to their respective Activity Leaders and the Component Leaders, to enable them to fulfil their reporting requirements. The Terms of Reference for Component, Activity and Task Leaders is set out in Appendix 11.

The overall expectations of Component 1 are presented in the annex to this component with indicators and targets for delivery. These indicators have also been used to establish mid-term and end-of-project targets to enable the relevant external project evaluations to be completed (see Table A15.11).

***Table A15.11**: Mid-term and End-of-project indicators and targets*

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Activity 1.1 Development of National N budget approaches				
Task 1.1.1 Development of National N budget approaches	Guidance Document on National Nitrogen budgets available and accepted.	UNECE Guidance document on National Nitrogen Budgets.	Two meetings held to develop material.	Guidance Document on National Nitrogen budgets delivered.
Task 1.1.2 Development of Farm N budgets	Guidance Document on Farm N budgets available and accepted.	0	Two meetings held to develop material.	Guidance Document on Farm N budgets delivered
Task 1.1.3 Development of NUE approaches	Guidance Document on NUE methodology for different purposes available and accepted	Guidance on NUE from UNECE, OECD, ONW, EU-NEP, GPNM with a need to harmonize & understand variants.	Two meetings held to develop material. One initial report published.	Guidance Document on NUE methodology for different purposes delivered
Task 1.1.4 Relating of Level & Effect Indicators to budget indicators	Guidance Document on relating Level & Effect indicators to budget indicators available and accepted	0	One meeting held to develop material, one initial report delivered.	Guidance Document on relating Level & Effect indicators to budget indicators delivered
Activity 1.2 Development of threat assessment methodology				
Task 1.2.1 Initial identification of Key Nitrogen Threats	Consultation document on key N threats and criteria for policy & other stakeholders available	0	Consultation document available and distributed	Consultation document available and distributed
Task 1.2.2 Conduct stakeholder review & refine N key threats & criteria	Summary of stakeholder feedback and revised set of key N threats and criteria available and accepted		Summary document completed and revised set of key N threats and criteria documented	Summary document delivered and revised set of key N threats and criteria documented
Task 1.2.3 Workshop(s) to review assessment methodologies for different N threats	Workshops on N threat assessment methodologies with synthesis on links held		Workshop report(s) on N threat assessment methodologies with synthesis on links	Workshop report(s) on N threat assessment methodologies with synthesis on links

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 1.2.4 Drafting guidance on overall N threat assessment methodology	Guidance Document on integrated N threat assessment methodology & compendium of primary documents available and accepted		[This Task starts in Yr3]	Guidance Document on integrated N threat assessment methodology & compendium of primary documents delivered
Activity 1.3 Development of methodology for N fluxes and distribution				
Task 1.3.1 Scoping of N flux and distribution methods (air, land, water, marine, trade)	Scoping report on N flux & distribution methods (air, land, water, marine, trade) available and accepted		Scoping report on N flux & distribution methods (air, land, water, marine, trade) delivered.	Scoping report on N flux & distribution methods (air, land, water, marine, trade) delivered.
Task 1.3.2 Conduct reviews of N flux and distribution methods for environ. compartments	Background Documents on N flux and distribution methods (to support workshop) available and accepted		Background Documents on N flux and distribution methods delivered to support workshop	Background Documents on N flux and distribution methods delivered to support workshop
Task 1.3.3 Workshop on harmonizing methodologies for key N fluxes and distribution	Workshop held on methods for N fluxes & distribution with synthesis		Workshop concept established including securing authors for background documents	Workshop report(s) on methods for N fluxes & distribution with synthesis delivered
Task 1.3.4 Preparing guidance on N flux & distribution methods, plus international support	Guidance Documents on N flux and distribution methods with compendium of primary documents available and accepted		[This Task starts in Yr3]	Guidance Documents on N flux and distribution methods with compendium of primary documents delivered.
Activity 1.4 Development of approaches for N threat-benefit valuation				
Task 1.4.1 Review of existing threat benefit valuation studies	Status report on N threat benefit valuation identifying key gaps & challenges available and accepted		Status report on N threat benefit valuation identifying key gaps & challenges delivered	Status report on N threat benefit valuation identifying key gaps & challenges delivered

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 1.4.2 Refinement of threat benefit valuation across contrasting economies	INMS briefing note summarising main principles of threat-benefit valuation conducted across contrasting economies available and accepted		INMS briefing note summarising main principles of threat-benefit valuation conducted across contrasting economies delivered	INMS briefing note summarising main principles of threat-benefit valuation conducted across contrasting economies delivered
Task 1.4.3 Integration of food, health, ecosystem, climate & energy benefits & threats	Methodology for linked valuation of multiple nitrogen benefits & threats available and accepted		Report from meeting to develop methodology for linked valuation of multiple nitrogen benefits & threats delivered	Methodology for linked valuation of multiple nitrogen benefits & threats delivered
Task 1.4.4 Valuation of threats & benefits under future nitrogen scenarios	Document on valuation of benefits and threats for future nitrogen scenarios available and accepted		[This Task does not start until Year 3]	Document on valuation of benefits and threats for future nitrogen scenarios delivered
Activity 1.5 Flux-impact path models for assessment, scenarios & strategy evaluation				
Task 1.5.1 Translation of storylines & scenarios into defined modelling requirements	INMS working document summarising the INMS modelling strategy including proposed approach to storylines and scenarios available and accepted		INMS working document summarising the INMS modelling strategy delivered	INMS working document summarising the INMS modelling strategy delivered
Task 1.5.2 Review of component models, criteria, data needs, information flow & outputs	Document on component models, data, info flow & outputs available including links to the INMS models database		Special report on component models, data, info flow & outputs delivered	Special report on component models, data, info flow & outputs delivered
Task 1.5.3 Design of model framework in relation to storylines, measures and indicators	Document on criteria & necessary components for integrated N modelling cluster available and accepted		Document on criteria & necessary components for integrated N modelling cluster delivered	Document on criteria & necessary components for integrated N modelling cluster delivered
Task 1.5.4 Application of selected component models in N model cluster	Demonstrated output for model cluster, linking N flows & effects global & regional		Meeting to plan the model cluster work	Report on INMS model cluster activities delivered
Task 1.5.5 Application of N model cluster for key scenarios at global/regional scales	Report on N flux/pathway modelling approach for global/regional scenarios available and accepted		[This Task does not start until Year 3]	Report on results from the application of the INMS model cluster for a selection of cases delivered to Component 2.
Activity 1.6 Examination of the barriers achieving to better nitrogen management				

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 1.6.1 Examination of economic, cultural & other factors that affect adoption of measures	Report on the economic & cultural factors helping/ hindering adoption of options available and accepted		Report on the economic & cultural factors helping/ hindering adoption of options delivered	Report on the economic & cultural factors helping/ hindering adoption of options delivered
Task 1.6.2 Global/regional examination of N barriers to change in food systems	Report on global/regional barriers to better N management in the food system available and accepted		Report from meeting on global/regional barriers to better N management in the food system delivered	Report on global/regional barriers to better N management in the food system delivered
Task 1.6.3 Global/regional examination of N barriers to change in consumption-production	Report on N barriers for global/ regional consumption-production available and accepted		Report from meeting on N barriers for global/ regional consumption-production delivered	Report on N barriers for global/ regional consumption-production delivered
Task 1.6.4 Exploration of options to overcome barriers including the role of a full N approach	Report informing global analysis & regional demos on overcoming barriers to change available and accepted		[This Task does not start until Yr3]	Report informing global analysis & regional demos on overcoming barriers to change delivered

Annex1 – Component 1 Results Framework

Outcomes and Outputs	Indicator	Baseline	Target	Sources of Verification	Assumptions
Outcome 1: Stakeholders, including policy makers, scientists, industry, farmers, business and civil society, have an agreed basis for informed decision making on N cycle management	Number of stakeholder groups using INMS tools and endorsing INMS procedures as a means to manage too much and too little N [P]	A fragmented approach in science input between different parts of the nitrogen cycle. Activities starting to join up N cycle at regional scale (e.g. TFRN, OECD), but not globally.	At least five user groups identifying INMS in their management actions International/regional bodies endorse use of tools (e.g. GPA, LRTAP, OECD, CBD, FAO, WMO)	• Published information • Working documents of international/ regional bodies	Buy-in from stakeholder to the INMS system Adequate communication between science assessments and policy development
Outcome 2: Stakeholders using agreed assessment and quantification methods to evaluate N cycle status acting as a common basis for regional / global scenarios to guide management actions.	Management actions in pilot areas (and more widely) using tools developed by INMS to inform decision making [P]	Lack of agreed assessment and quantification methods to support management of the nitrogen cycle. Preliminary basis on N effect and system indicators, but lacking coherence.	At least five stakeholder groups using tools developed by INMS to inform decision making International/regional bodies endorse use of methodologies	• Published information • Working documents of international / regional bodies	Adequate communication between science assessments and policy development Willingness to utilize approaches for developing strategies for N management
Output 1.1: Development of Indicators for assessing full N budgets, use, levels and impacts, including N use efficiency and benchmarking. Indicators would be developed of relevance for specific stakeholders	Guidance documents for specific applications and stakeholders published on web portal [P]	Guidance on N budgets and NUE from UNECE, OECD, ONW, EU-NEP, GPNM with a need to harmonize & understand variants	Completion /Acceptance of Guidance Documents for: • National N budgets (Yr 4) • Farm N budgets (Yr 3) • NUE methodology (Yr 3) • Relating level and effect to N budget indicators (Yr 4)	• PPA & PMB minutes • Project reports • Project website	Consensus on common global approaches for indicators achieved
Output 1.2: Methodology for threat assessment	Reports on work on methodologies published on web portal [P]	No methodology for regional / global threat assessments for N_r	Completion/acceptance of key reports: • Report on N threats and criteria (Yr 1) • Response from stakeholders on threats and criteria (Yr 1) • Workshop report on N threat assessment methodology (Yr 2) • Guidance on integrated N threat assessment methodology (Yr 3)	• PPA & PMB minutes • Project reports • Project website	Consensus on common regional/global approaches for threat assessment achieved
Output 1.3: Methods for determining N fluxes and distribution (water, air, land, agriculture, industry, etc.)	N flux methods & reports published on web portal [P]	Fragmented methodologies for different parts of the nitrogen cycle and for different regions. No joined up synthesis available.	Targeted reports on: • N fluxes & distribution (Yr 1) • Background document (to support workshop) on N fluxes and distribution (Yr 2) • Workshop report on N fluxes and distribution (Yr 3) • Guidance document on fluxes and distribution methods (Yr 4)	• PPA & PMB minutes • Project reports • Project website	Consensus on common regional/global approaches for determining N fluxes and distribution achieved
Output 1.4: Approaches to estimate the value of N threats and benefits	Valuing threats and benefits, methods & reports published on web portal [P]	Cost-benefit analysis for nitrogen so far conducted only for Europe, USA and China, with a need to harmonize approaches and agree common principles to allow wider application	Targeted reports on: • N threats & benefit valuation, gaps & challenges (Yr 1) • Threat-benefit valuation for global/regional comparisons (Yr 2) • Methodology for integrating benefits & threats across food, health, ecosystem, climate etc. (Yr 3) • Valuation of benefits & threats under future scenarios (Yr 4)	• PPA & PMB minutes • Project reports • Project website	Access to necessary data within timeframe of the project
Output 1.5: Approach to using existing N flux/pathway models for regional assessments and visualisation for potential scenarios to assist with development and reduction strategies.	Methods, database and reports in relation to models and scenarios, published on web portal [P]	Existing modelling of nitrogen cycle mainly fragmented into different issues. There is a need to link up between N forms, N effects and from biophysical to economic modelling in order to highlight the co-benefits of better nitrogen management.	Targeted reports including: • Database on models, data needs, information flows, etc. • Criteria for N modelling to address management options and scenarios (Yr 1) • Application of selected N models as a cluster (Yr 3) • N flux/pathway modelling demonstrated for global/regional scenarios (Yr 3) • Key outcomes from model runs uploaded to database	• PPA & PMB minutes • Project reports • Project website	Consensus on cluster of suitable models achieved Linkages of suitable models can technically be achieved on a useable timescale
Output 1.6: Understanding the barriers to change at all levels of society (government, private sector and civil society) including technical, financial and socio-political limitations.	Reports on barriers to change published on web portal [P]	Until now there has been little strategic analysis of the barriers to better nitrogen management. ENA and ONW highlight role of stakeholder complexity and need to find nexus points.	Targeted reports including: • Examination of economic, cultural & other factors impacting adoption of N management options (Yr 1) • Examination on global/regional N barriers to change in the food system and in consumption/production (Yr 3) • Options to overcome barriers to inform global approach and regional demos. (Yr 4)	• PPA & PMB minutes • Project reports • Project website	Access to necessary data within timeframe of the project, across relevant levels of society

ACRONYMS USED IN THE TABLE: CBD, UN Convention on Biological Diversity; ENA, European Nitrogen Assessment; EU-NEP, European Union Nitrogen Expert Panel; FAO, UN Food and Agriculture Organisation; PPA, Project Partners Assembly of all INMS partners; GPA, Global Programme of Action for the Protection of the Marine Environment from Land-based Activities; GPNM, Global Partnership on Nutrient Management; INI, International Nitrogen Initiative; LRTAP, UNECE Convention on Long-range Transboundary Air Pollution; NUE, Nitrogen Use Efficiency; OECD, Organisation for Economic Cooperation and Development; ONW, Our Nutrient World; PMB, Project Management Board; UNECE United Nations Economic Commission for Europe; WMO, World Meteorological Organisation;

Annex 2 - Terms of Reference for Partners and Consultants

Terms of Reference for the roles of Component, Activity and Task Leader along with potential consultants, is included in Appendix 11. The remit of these roles, along with decisions on the institutions and persons taking on these roles for each Component, will be subject to endorsement by the Project Partners Assembly at the Inception meeting of the project.

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 16

Component 2: Global quantification of N flows, threats & benefits

Table of Contents

1 Component Identification

1.1 Component Summary

The aim of this component is to apply tools, methods and data to synthesize knowledge on nitrogen flows, threats and benefits in the context of the global nitrogen cycle. It will apply key inputs in the form of tools and methods developed in Component 1, together with outcomes from the regional demonstration activities of Component 3, to analyse the current status of N flows, threats and benefits. While the first target is the global scale, it will necessarily use the regional activities to illustrate regional variation in context as well as the possible solutions. Where possible this component will also support regional demonstrations by providing regional results of the flux and impacts models to the demonstration studies. Options for improved nitrogen management in different contexts will consider the multiple benefits, linking water, air, greenhouse balance, ecosystems and soils, as well as the interactions with food and energy. These elements will inform the development of storylines and scenarios of different "nitrogen futures" and how these relate to cost-benefit analysis. The work will provide key high-level outputs that will support awareness raising and knowledge sharing of Component 4. The targeted research of Component 3 therefore will help develop global policy framing for nitrogen, providing an improved basis for transformational actions on nitrogen management, globally and regionally.

The main elements are as follows:

1) Application of a suite of modelling tools to quantify nitrogen flows, threats and benefits at global and regional scales, including developing a shared database of inputs and model outcomes, provision of international support for regional inventory and model development, and integrated analysis to quantify present and future threats and benefits.

2) Preparation of a first global assessment of N fluxes, pathways and impacts, assimilating lessons from the regional demonstrations (and vice versa), including: scoping the structure of the consolidated global assessment, commissioning author teams, drafting and peer review, preparation of summary documents and review, publishing and distribution of the consolidated assessment. The work will draw on the outcomes of Components 1 and 3, while providing material to support the actions of Component 4.

3) Integrating methods, measures and good practices to address issues of excess and insufficient reactive nitrogen, including preparation of a document on the state-of-the-art for good nitrogen management, considering different N forms and N effects. It will include workshops to develop methods that link good practices for N effects (linked to food, energy, water, air, climate, biodiversity etc) and lead to preparation of international guidance on approaches for improved management of the nitrogen cycle.

4) Exploration of future N storylines and scenarios with management /mitigation options and cost-benefit analysis, including review of existing N policies for different countries and regions and review of existing storylines and scenarios. It will lead to a published strategy on scenarios and storylines, together with a report on N policy options and their possible contribution to development of the Green Economy / Circular Economy.

5) Collation and synthesis of the experience of measures for improved nitrogen management as adopted by GEF and others, including UNEP, OECD, FAO etc in sharing and disseminating success stories including lessons learned though case studies at national and local levels. These case studies will complement and further enhance the Regional Demonstrations of Component 3.

Together the outcomes of these key elements will lead to clear recommendations for stakeholders in food systems, industry and for policy makers at global, national and regional levels, to be disseminated in engagement with Component 4 on awareness raising and knowledge sharing.

1.2 Links with other Components

This component draws on outcomes from Components 1, 3 and 4 and in-return provides inputs back to each of these components. Component 1 provides tools and methods for use in Component 2, which in turn support the context development for prioritization of issues/threats/approaches that are needed to inform the tool development. Specifically, A2.2 (global assessment perspective) and A2.3 (guidance for better N management) and A2.4 (future scenarios) will inform on the requirements for model and tool development in A1.5. By delivering support for regional inventory and model development (Task 2.1.2), the component will support the regional demonstration work of Component 3, while in turn, the outcomes from the regional demonstrations will inform the development of future scenarios and good practice guidance (A2.4, A2.3). At the same time Component 3 will provide regional and local case studies for inclusion in the global nitrogen assessment process (A2.2). Component 2 includes activity to collate and synthesise knowledge, experience and measures from previous GEF and other initiatives (A2.5), which will provide material directly relevant to both A2.2 and A2.3 as well as to knowledge sharing and dissemination in Component 4. Products from Component 2 will be harmonized and disseminated through actions in Component 4, utilizing the publication function of A4.5 and delivering products for use in wider international engagement (A4.3-A4.4), training and diffusion (A4.2).

2 Component Design

2.1 Background and context

The core aim of INMS is to develop the scientific basis to support international policy development across the nitrogen cycle. In addition, it may also contribute to certification in industry, food systems and retail (through Activity 2.3). To date, most efforts have focused on single environmental compartments and issues, such as water, air, climate, ecosystems and soils. The result is that there has been insufficient attention given to showing how joined-up management of the nitrogen cycle can deliver multiple benefits for food, energy, environment and health, and in doing so help overcome the barriers-to-change. To address this challenge requires that existing information be strongly integrated in a process that builds mutual recognition between different sectors of interest (e.g. water, air, climate, health, energy, food etc) and at the same time develops the next generation of global intellectual capacity needed to work towards a more sustainable world.

Several key elements are necessary to achieve transformational change at the global scale, while drawing on the contributions of different regions:

- Advances in nitrogen modelling capability need to be applied to show how sources, inputs and effects of nitrogen vary globally in space and time.
- The evidence of nitrogen effects and the outcomes that can be delivered by more joined up nitrogen management need to be synthesized in order to see the bigger picture, identify key priorities and drive the global agenda forward.

- Specific actions for better nitrogen management need to be distilled and summarized into readily accessible guidance that can be used by governments, advisory organisations, and business managers to take up opportunities for improved nitrogen management.
- Key stakeholders including policy makers need to see what a business-as-usual scenario for nitrogen would look like and to understand how much this picture could be changed by adoption of the best nitrogen management practices. This calls for the development of robust models that can address future storylines and scenarios.
- The process needs to integrate actors from different *sectors* (nitrogen source sectors and users, those benefitting from and threatened by nitrogen flows) and *disciplines*, ranging from natural and social scientists, resource and business managers, policy analysts and experts in governance systems.
- Information from GEF and others from a wide range of sources, including UNEP, OECD, FAO, UNECE and others, needs to be collated and made into an accessible form so that it can be best used to inform the global synthesis.

To date, most work in modelling of nitrogen flows, fate and effects has been conducted in a piecemeal fashion with a typically high degree of separation between modelling and monitoring communities related to the different issues (e.g. water, air, climate, agriculture, energy etc). 'Towards INMS' is a first major project to bring these elements together at the global scale. The work therefore needs to proceed in a stepwise fashion in order to be achievable. For example, this may imply that successive meetings in different parts of INMS focus on pairing different communities, rather than attempting to link all issues in one step.

The establishment of a synthesis activity to produce a definitive global nitrogen assessment has been a central goal of INI over the last decade that has also developed with a stepwise approach. Activities in Europe, North America, India, China, Latin America and Africa have contributed to regional nitrogen assessments. These INI Regional Centres worked together with GPNM to produce the Global Overview of Nutrient Management – 'Our Nutrient World'.[1] In this way these products have had a major global impact in driving nitrogen science forward, making it more relevant to the needs of policy and practice and in raising public awareness. This is clearly illustrated by Our Nutrient World, which led to over 300 media responses world-wide, with many articles in the press and radio, as well as television contributions.[2] The experience shows that strong science synthesis, focused on providing solutions to societal needs, has a major global impact in raising public awareness. As such, it must a key foundation for global transformational change related to the nitrogen cycle.

When it comes to the provision of guidance for better management actions, the emerging challenge is to provide guidance that can deliver significant nitrogen co-benefits for cleaner water, cleaner air, reduced greenhouse gas emissions, healthier ecosystems, together with increased crop yields, livestock production and improved profits for other business sectors. The starting point is a wealth of information on nitrogen guidance linked to single issues and effects. Examples are guidance on nitrogen in water management or relating to

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[1] Sutton M.A., Bleeker A., Howard C.M., Bekunda M., Grizzetti B., de Vries W., van Grinsven H.J.M., Abrol Y.P., Adhya T.K., Billen G.,. Davidson E.A, Datta A., Diaz R., Erisman J.W., Liu X.J., Oenema O., Palm C., Raghuram N., Reis S., Scholz R.W., Sims T., Westhoek H. & Zhang F.S., with contributions from Ayyappan S., Bouwman A.F., Bustamante M., Fowler D., Galloway J.N., Gavito M.E., Garnier J., Greenwood S., Hellums D.T., Holland M., Hoysall C., Jaramillo V.J., Klimont Z., Ometto J.P., Pathak H., Plocq Fichelet V., Powlson D., Ramakrishna K., Roy A., Sanders K., Sharma C., Singh B., Singh U., Yan X.Y. & Zhang Y. (2013) *Our Nutrient World: The challenge to produce more food and energy with less pollution.* Global Overview of Nutrient Management. CEH Edinburgh, on behalf of GPNM and INI. 114 pp.

[2] Smith, B.P., Burns, P. & Reading, S. (2013) Communicating 'Our Nutrient World' – a report for UNEP (Published 18 February 2013). March 2013. Centre for Ecology & Hydrology 12 pp. See also Sutton M.A., Howard C.M., Bleeker A. and Datta A. (2013) The global nutrient challenge: From science to public engagement. *Environmental Development* **6**, 80-85.

emissions to air. Many different national and international organisations have established their own guidance documentation linking to different parts of the nitrogen cycle. This is a point that has recently been recognized by the UNECE through its Task Force on Reactive Nitrogen, which is now seeking to develop UNECE guidance documentation for air, water and climate co-benefits. This work will contribute to the wider Towards INMS Activity 2.3, which will cover a much more diverse set of economic, climatic and soil conditions. In this way the work of Towards INMS can build on common interests of many national and international bodies, including UNEP, GEF, UNECE, OECD, CBD, UNFCCC, FAO, WHO and others. For example, the global approach of Towards INMS needs to consider both regions with excess and insufficient nitrogen. In both cases, improved management to reduce nitrogen losses should hold the prospect to improve productivity significantly.

The challenge also extends beyond agriculture, including strengthening links with approaches to reduce losses of nitrogen through waste water and combustion. In principle further efforts are needed to develop and test strategies that focus on reducing denitrification and promoting reuse and recycling of all available nitrogen sources. This has significant implications for current technologies based on denitrification (e.g. catalytic and non-catalytic NO_x reduction, tertiary water treatment) pointing to the opportunity for next generation systems that recycle N_r as a valuable resource rather than destroy this resource by denitrification back to N_2.

Much work has been done on scenarios for different processes that is highly relevant for INMS. Here the central challenge will be to decide to what extent Towards INMS can use and build on existing processes working on scenario and story-line development (e.g. the Representative Concentration Pathways, RCP, and Shared Socio Economic Pathways, SSP, of IPCC). Conversely, it needs to be agreed to what extent new scenario approaches are needed that are better-fitted to address the multi-dimensional nature of the global nitrogen challenge. For example, new indicators being developed in Component 1, such as new formulations of nitrogen use efficiency (NUE), N surplus and effect indicators, as well as the developing concept of Planetary Boundaries, will inform the approach to be discussed and adopted by INMS. The scenario analysis will utilize outcomes from the work on Cost-benefit analysis and on social/cultural barriers to change for nitrogen as developed in Component 1.

Overall, the core task of Component 2 is to show how a joined-up approach can strengthen recognition of the multiple benefits of improved nitrogen management. It will incorporate modelling and scenario activities, collation of existing knowledge and preparation of high level synthesis outcomes that provide the evidence necessary to deliver clear recommendations and support transformational actions by governments, business and citizens alike.

Key Outputs of Component 2 are:

Output 2.1. Quantification & assessment of the regional threats from excess N and insufficient N (including consideration of interactions with other biogeochemical cycles).

Output 2.2. Detailed overview of regional/local N flux and consolidation into a global assessment of N fluxes, pathways, effects and benefits of improved N management

Output 2.3. Consolidation of methods and good practices to address issues of excess and insufficient reactive nitrogen

Output 2.4. Definition of programmes and policy options for improved reactive nitrogen management at local/regional/global levels, supported by cost-benefit analysis to underpin options for the Green Economy.

Output 2.5. Compendium summarizing the state of knowledge, experience and measures adopted by GEF (and others) gained from addressing the issues of excess and insufficient reactive nitrogen.

2.2 Baseline

2.2.1 Baseline analysis

Current Status of Global Nitrogen Modelling

In Component 1, we already described currently available global models including nitrogen compounds. This includes the Global Nutrient Model within IMAGE (IMAGE-GNM) that has been applied to assess global scale spatially explicit land N (and P) budgets in livestock and crop production systems in the past and in the future (1900 to 2050) in response to various scenarios.[3] The budgets include inputs by fertilizer, manure, fixation and deposition and outputs by crop uptake, losses to air by emissions of ammonia (NH_3), nitrous oxide (N_2O), nitrogen oxides (NO_x = NO and NO_2) and dinitrogen (N_2) as well as losses (runoff) to water. Results showed that in the beginning of the 20th century, nitrogen budgets were either balanced or surpluses were small; between 1900 and 1950, global soil N surplus almost doubled from 20 to 36 $Tg{\cdot}yr^{-1}$ and between 1950 and 2000, the global surplus increased to 138 $Tg{\cdot}yr^{-1}$ of N. The future predictions in response to various scenario indicate increasing global crop (+82% for 2000–2050) and livestock production (+115%) and despite rapidly increasing recovery in crop and livestock production (both +35%), global nutrient surpluses are predicted to increase by 23%. The model predictions further show that combinations of intensification, better integration of animal manure in crop production, and matching N and P supply to livestock requirements can make effective contributions to reduce nutrient flows.

The global scale NH_3 and NO_x emissions of the IMAGE-GNM model, in combination with various other global N emissions estimates, such as results from the EDGAR database, have been used in atmospheric emission deposition models, such as TFM to assess global scale spatially explicit N deposition trends for the same period (1900-2050)[4]. As with N surpluses, results of global scale N deposition also show a strong increase in N deposition between 1950 and 2000 and a further expected increase in 2050 in large parts of Asia while reductions are predicted for Europe and the US. Results of these N deposition models have been used to assess global scale impacts on plant species diversity, in interaction with other drivers affecting biodiversity, including land cover change, land-use intensity, fragmentation, climate change and infrastructure development, using the GLOBIO model.[5] Model results indicate that impacts of climate change, nitrogen deposition, fragmentation, and infrastructure all together reduce mean plant species abundance (MSA) by ca 10%. N deposition results have also been used in earth system models predicting changes in the net primary production and carbon sequestration of terrestrial ecosystems in response to N deposition, ozone exposure, CO_2 and climate. In a most recent study, results show that 19% of the recent (1990–2007) and 24% of the historical global C sink (1900–2006) was driven by N deposition effects.[6] The global scale N (and P) surpluses in

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[3] Bouwman AF, Klein Goldewijk K, van Der Hoek KW, Beusen AHW, van Vuuren DP, Willems J, Rufino MC, Stehfest E. (2013) Exploring global changes in nitrogen and phosphorus cycles in agriculture induced by livestock production over the 1900-2050 period. *Proc. Natl. Acad. Sci. USA* **110**, 20882–20887.

[4] Dentener F, Drevet J, Lamarque JF, Bey I, Eickhout B, Fiore AM, Hauglustaine D, Horowitz LW, Krol M, Kulshrestha UC, Lawrence M, Galy-Lacaux C, Rast S, Shindell D, Stevenson D, Van Noije T, Atherton C, Bell N, Bergman D, Butler T, Cofala J, Collins B, Doherty R, Ellingsen K, Galloway J, Gauss M, Montanaro V, Müller JF, Pitari G, Rodriguez J, Sanderson M, Solmon F, Strahan S, Schultz M, Sudo K, Szopa S, Wild O. (2006) Nitrogen and sulfur deposition on regional and global scales: A multimodel evaluation. *Glob. Biogeochem. Cycles* **20**, GB4003.

[5] Alkemade R, van Oorschot M, Miles L, Nellemann C, Bakkenes M, ten Brink B. GLOBIO3 (2009) A Framework to Investigate Options for Reducing Global Terrestrial Biodiversity Loss. *Ecosystems* **12**, 374-390.

[6] Fleischer, K., D. Wårlind, M. van der Molen, K. Rebel, A. Arneth, J.W. Erisman, M. Wassen, B. Smith, C. Gough, H. Margolis, A. Cescatti, L. Montagnani, A. Arain and H. Dolman (2015) Low historical nitrogen deposition effect on carbon sequestration in the boreal zone. *Journal of Geophysical Research – Biogeosciences*. DOI: 10.1002/2015JG002988.

combination with estimates of N (and P) point sources of the IMAGE-GNM model, have also been used to assess N runoff to rivers and oceans in response to those point and diffuse N sources with the Global NEWS model for the period 1970-2050[7] and more recently with IMAGE-GNM for the period 1900-2100.[8,9]

Baseline for Global assessment of nitrogen fluxes, pathways and impacts

A number of recent activities provide useful input to the global nitrogen assessment process of INMS. A starting point can be found in the INI activities to develop regional assessments. These include the European Nitrogen Assessment,[10,11] the US assessment of nitrogen climate interactions,[12,13] the US EPA nitrogen assessment[14] and the Indian Nitrogen Assessment process.[15] These have been complemented by more specific activities at a global scale, including the 'Our Nutrient World' report for UNEP, the synthesis published by the Royal Society of London,[16] and the report of UNEP on 'Drawing Down N_2O' emissions.[17] The results from each of these will contribute to the consolidated global nitrogen assessment of N fluxes, pathways and impacts to be developed by INMS.

Status of Guidance on improved nitrogen management

The following provide important starting points in the development of guidance documentation on better nitrogen management practices:

- The UNEP report 'Drawing down N_2O' [15] was developed with input from INI and GPNM and focused on demonstrating the available methods for reducing nitrous oxide emissions, as well as looking at the opportunities and barriers linked to the Green Economy, and considering scenarios into the future.

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[7] Mayorga E, Seitzinger SP, Harrison JA, Dumont E, Beusen AHW, Bouwman AF, Fekete BM, Kroeze C, van Drecht G. (2010) Global Nutrient Export from WaterSheds 2 (NEWS 2): Model development and implementation. *Environmental Modelling and Software* **25**, 837-853.

[8] Beusen, A. H. W., Van Beek, L. P. H., Bouwman, A. F., Mogollón, J. M. & Middelburg, J. J. (2015) Coupling global models for hydrology and nutrient loading to simulate nitrogen and phosphorus retention in surface water. Description of IMAGE-GNM and analysis of performance. *Geoscientific Model Development* **8**, 4045–4067.

[9] Beusen, A. H. W., Bouwman, A. F., Van Beek, L. P. H., Mogollón, J. M. & Middelburg, J. J. (2016) Global riverine N and P transport to ocean increased during the twentieth century despite increased retention along the aquatic continuum. *Biogeosciences (in press)*.

[10] Sutton M.A., Howard C., Erisman J.W., Billen G., Bleeker A., Grennfelt P., van Grinsven H. and Grizzetti B. (2011) *The European Nitrogen Assessment: Sources, Effects and Policy Perspectives* (Eds.) Cambridge University Press. 612 pp.

[11] De Vries, W., Cellier P., Erisman J.W. and Sutton M.A. (2011) Assessment of nitrogen fluxes to air and water from site scale to continental scale (Eds). (NitroEurope Special Issue) *Environ. Pollution,* **159** (11), 3143-3268.

[12] Suddick E.C., Whitney P., Townsend A.R. & Davidson E.A. (2012) The role of nitrogen in climate change and the impacts of nitrogen–climate interactions in the United States: foreword to thematic issue. Biogeochemistry, DOI 10.1007/ s10533-012-9795-z;

[13] Davidson E.A., David M.B., Galloway J.N., Goodale C.L., Haeuber R., Harrison J.A., Howarth R.W., Jaynes D.B., Lowrance R.R., Nolan B.T., Peel J.L., Pinder R.W., Porter E., Snyder C.S., Townsend A.R. & Ward M.H. (2012) Excess nitrogen in the U.S. environment: trends, risks, and solutions. Issues in Ecology, Report Number 15, Ecological Society of America.

[14] USEPA Science Advisory Board, Integrated Nitrogen Committee (2011) Reactive Nitrogen in the United States: An analysis of Inputs, Flows, Consequences, and Management Options. EPA-SAB-11-013. United States Environment Protection Agency.

[15] Abrol Y.P., Raghuram N. & Chanakya H.N. (Eds.) (2008) Reactive Nitrogen in Indian Agriculture, Environment and Health. *Current Science* (Nitrogen Special Issue) **94**, 1375-1477.

[16] Fowler D., Pyle J.A., Raven J.A. and Sutton M.A. (2013) The global nitrogen cycle of the twenty-first century. *Philosophical Transactions of the Royal Society, Series B.* **368** (1621)

[17] UNEP (2013) *Drawing Down N_2O to Protect Climate and the Ozone Layer.* A UNEP Synthesis Report. (Eds.: J. Alcamo, S.A. Leonard, A.R. Ravishankara and M.A. Sutton). United Nations Environment Programme, Nairobi.

The conclusions emphasized the need to address nitrous oxide control in the wider context of the global nitrogen cycle.

- The UN Framework Convention on Climate Change (UN FCCC) includes panels developing best practices for reporting of greenhouse gas emissions. There are several commonalities here with nitrogen, not just in relation to nitrous oxide, but also in developing the systems needed for sound emissions reporting. In this regard, the work of the UNFCCC strongly complements that of the Task Force on Emissions Inventories and Projections (TFEIP) of the UNECE EMEP process.
- The GEF/UNEP Global Nutrient Cycles project, on establishing the foundations for global nutrient management, has been developing a Tool Box Approach listing different kinds of good practices for better nutrient management in the form of a web-based application. This can provide a useful source of information for future studies and complements more traditional 'guidance document' based approaches. The project also developed the Lake Chilika report card, which constitutes a visualization approach for summarizing key environmental indicators and showing how a site is performing in relation to these indicators.
- The Food and Agriculture Organization of the United Nations (FAO) is developing guidance for better management of livestock systems, in particular through its Livestock Environmental Assessment and Performance (LEAP) partnership. This includes development of guidance documents for the livestock sector where better nitrogen management can play a key role. These documents complement wider outlook activities such as the FAO annual State of Food and Agriculture (SOFA) reports.
- FAO has also commissioned a number of publications on fertilizer use by crop in different countries. The objective is to demonstrate the importance of information on fertilizer use by crop, on a national level and by agro-ecological zone. It also aims to demonstrate how the correct use of fertilizers could help to achieve some of the Sustainable Development Goals (SDGs) of the United Nations, i.e. eradicate extreme poverty and hunger[18].
- The Long-range Transboundary Air Pollution (LRTAP) convention of the UNECE has published a revised guidance document on methods to reduce ammonia emissions from agricultural sources,[19] together with the accompanying UNECE Framework Code.[20] While the focus is on emissions to the atmosphere, these also include a sections on good nitrogen management across the nitrogen cycle in relation to all nitrogen sources and possible impacts.

These examples provide only a selection. However, they illustrate the diversity of relevant actions that provide the baseline for Towards INMS. Other initiatives will be incorporated into the Towards INMS networking as the project develops.

2.2.2 Gaps

The main gaps in relation to Component 2 are as follows:

- **A coherent suite of nitrogen flow and impact models** is currently missing to provide a clear picture of how nitrogen leads to multiple benefits and threats for society, linking environment (water, air,

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[18] FAO (2006) Fertilizer use by crop. FAO Fertilizer and Plant Nutrition Bulletin 17. Food and Agriculture Organization of the United Nations, Rome. [ISBN 978-92-5-105592-2]

[19] Bittman, S., Dedina, M., Howard C.M., Oenema, O. and Sutton, M.A. (2014) (eds.) *Options for ammonia mitigation: Guidance from the UNECE Task Force on Reactive Nitrogen.* TFRN-CLRTAP, Centre for Ecology and Hydrology, UK. [ISBN: 978-1-906698-46-1]

[20] UNECE (2015) *United Nations Economic Commission for Europe Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions*. United Nations Economic Commission for Europe, Geneva.

climate, biodiversity, health), food and energy outcomes. Such an agreed suite needs to be assembled that develops broad approval as an authoritative source of information about the nitrogen cycle.
- **The shape of dose-impact relationships** for some effects across the nitrogen cycle.
- **Effects of food trade, land grabbing and Trans-National Corporations** on the efficiency of nitrogen use, recycling and losses are not well understood and captured in current modelling approaches.
- **A synthesis on the current flows, impacts, mitigation options, consequences of not taking action and the opportunities for change** is currently missing that can support policy development, better management and transformational change.
- There is currently no available **guidance for joined-up management of the nitrogen cycle**, bearing in mind the multiple co-benefits.
- There is no coordinated set of **storylines and scenarios** in relation to the multiple benefits and threats of nitrogen (e.g. as compared to the issue of climate change).
- Information from **interventions for better nitrogen management**, including achievement through GEF and other interventions has not been brought together.

Additional funding

Further funding is needed to develop each of these areas. This Component provides a start to address these issues. At the same time the activity provides a framework that can catalyse the development of parallel funding initiatives to further strengthen the global critical mass. Examples of new initiatives that will complement the work include:

- **INMS Pump Priming:** This UK NERC project aims to develop the basis for nitrogen integrated assessment modelling through funding workshops and network development. (A first workshop was already held during 2015 to support the INMS project preparation phase).
- **TFRN Guidance on nitrogen management for co-benefits to air, climate, water and biodiversity**: Outline funding is agreed with the EU to fund a workshop on options for better nitrogen management for multiple co-benefits, which will contribute directly to A2.3.
- **NEWS India-UK:** This project to be funded by the Newton-Bhabha fund supports bi-lateral research between these two countries, addressing the Nitrogen Efficiency of Whole-cropping Systems (NEWS India-UK). In particular it will address the extent to which there are co-benefits to be found by linking improvement strategies for plant NUE, agronomic NUE, farm-scale NUE and national scale NUE.
- PhD studies at **Wageningen University** dealing with the effects of globalization of food production on the efficiency of nitrogen use at global and regional levels
- The **EU Nitrogen Expert Panel** aims to contribute to improving nitrogen use efficiency (NUE) in food systems in Europe, through (i) communicating a vision and strategies on how to improve NUE in agriculture and food systems; (ii) generating new ideas, and recommending effective proposals and solutions; and by (iii) acting as referee in controversial issues, and by communicating with authority about nitrogen issues.

Other projects linking to INMS are coming on-stream (e.g. including Newton fund projects) that will further develop the underpinning of the developments in Towards INMS.

2.2.3 Stakeholder analysis

The main stakeholders for Component 2 are institutions and businesses that are active in releasing nutrients and, specifically, nitrogen compounds to the environment, or institutions/businesses that are affected by resulting impacts. These stakeholders benefit from an improved guidance on good nitrogen management practices, overall science synthesis and communication. Work therefore has high relevance to a wide range of stakeholders, providing underpinning to support Component 4 on awareness raising and knowledge sharing.

Key stakeholders in Component 2 can be summarized under the following headings:

Guidance on better nitrogen management and collation of existing knowledge: UNEP, GEF, LRTAP, TFRN, CBD, IPCC, GPA, GPNM, OECD, FAO, WHO, EU-NEP, SDSN, industries (e.g. fertilizer industry, farming organizations, water management organizations, nature management organizations), NGOs and countries contributing to these processes.

Private Sector: The private sector provides a sounding board in relation to their own business interests and what opportunities they see to strengthen competitiveness. Several business organizations are included including the International Fertilizers Manufacturers Association, Fertilizers Europe, BASF, Yara, the International Plant Nutrition Institute, as well as other business organizations such as the European Federation of Agricultural Engineers, with farmer groups being involved through Component 3.

Global assessment of N fluxes, pathways and impacts: UNEP, including UNEA, GEF, LRTAP, CBD, IPCC, IBPES, GPA, GPNM, OECD, WMO, WHO, SCOPE and Future Earth, as well as the various science groups (partners), industries (e.g. fertilizer industry, farming organizations, water management organizations, nature management organizations), NGOs and countries contributing to these processes.

Global and regional modelling of the nitrogen cycle: INI, Future Earth, SCOPE, LRTAP Hemispheric Task Force (HTAP), LOICZ, implemented through partner members.

Development of future storylines and scenarios: UNEP, OECD, IPCC, LRTAP, GPA, CBD, GEF, TFRN, GPNM, FAO, WHO, industries (e.g. fertilizer industry, farming organizations, water management organizations, nature management organizations), NGOs and countries contributing to these processes.

The roles of the different stakeholder groups can be summarized as follows:

Government and international agreements: The international agreements provide a mechanism for INMS to engage with governments, mobilizing them with the opportunities offered by better nitrogen management. In this sense they represent both users of the work and a source of international advice and feedback on priorities for action. In practice, representatives of these processes provide advice to Towards INMS, while INMS reaches out to support their processes.

International Science Community: This is represented particularly by INI as a body linked to SCOPE and Future Earth. The science community is also linked through other evidence gathering processes including TFRN, IPCC and IPBES.

Wider stakeholder involvement with NGOs will particularly come through Components 3 and 4. However, relevant stakeholders in relation to the methods include Future Earth and the Planetary Boundaries Initiative.

2.3 Overall objective and outcome

Component 2 forms a key part of Towards INMS contributing to its **Overall Project Objective:**
To improve the understanding of the global/regional N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to increase the benefits and reduce negative impacts of reactive nitrogen on the ecosystems.

Specifically Component 2 will lead to the following outcome:

Overall Outcome 2: *Regional and Global information on N cycle fluxes and impacts, enabling strategies to be implemented to increase the benefits and minimise negative effects of excess or insufficient reactive N, while maximising the quantified co-benefits for other sectors including the Green Economy*

This outcome must be seen in the wider context of the project. The focus here is on utilizing outcomes from Component 1 and 3 to provide key resources to stimulate improved management of the global nitrogen cycle, delivering results that can be exploited in wider awareness raising and knowledge sharing in Component 4.

Note that Outcomes are defined at Component level, while detailed Outputs at Activity and Task levels are described in the following sections.

2.4 Outputs and activities

Overall Component Co-Leads: European Centre of INI (de Vries, WUR) and Latin American Centre of INI (Ometto, INPE).

2.4.1 Activity 2.1 : Quantifying N flows, threats and benefits at global and regional scales

Output 2.1 Quantification and assessment of the global and regional threats from excess and insufficient reactive nitrogen

Activity Co-Leads: European Centre of INI (de Vries, WUR) and North American Centre of INI (Marine, tbc).

The elements of this activity are summarized visually in Figure A16.1. These include, establishing a database of shared input and outcomes, providing support to regional inventories and model application, combined analysis of present conditions, and quantifying future threats and benefits at regional and global scales. Together, these elements provide the tasks needed to apply the modelling and measurement developments to build a state-of-the-art picture of current and future N flows, threats and benefits.

The main focus will be on supporting the application of models of the nitrogen cycle that have been developed through activities linked to Component 1 (A1.5). This will include the review and critical assessment of existing models and the review of associated literature. For this work, it will be necessary to develop a common position on the data sources needed for modelling, which will form a key part of the databasing activity (Task 2.1.1). It will not be possible to support major measurement activities with the level of GEF resources available to Towards INMS. However, links will be made with nitrogen measurement programmes in water, air, soil etc enabling the databse to make the links to key data sources. This will benefit from the activities in Component 1 on threats, fluxes and levels (A1.2, A1.3).

With Towards INMS bringing together leading expertise in modelling and measurement of the nitrogen cycle, there is also the opportunity to share the emerging findings between regions, especially in considering how messages emerging from Component 3 feed into the modelling needs, and return to feed regional results from Component 2 back to Component 3. Available methodologies and those developed in Activity 1.5 will therefore also be shared with the regional demonstration activities to support their work. The core focus will be on supporting the establishment of regional inventories and on model application. However, sharing of expertise on measurement approaches will be encouraged, drawing on the outcomes of Activities 1.2 and 1.3, especially through national INMS co-financing initiatives.

The largest fraction of this activity is dedicated to application of the developed models for different parts of the nitrogen cycle, with particular emphasis on the application of the model cluster to be established in Activity 1.5. While the first stage is on developing a joined-up model assessment of the main sources, flows, threats and benefits for current conditions, input from Activity 2.4 will be used to inform the model application for future scenarios.

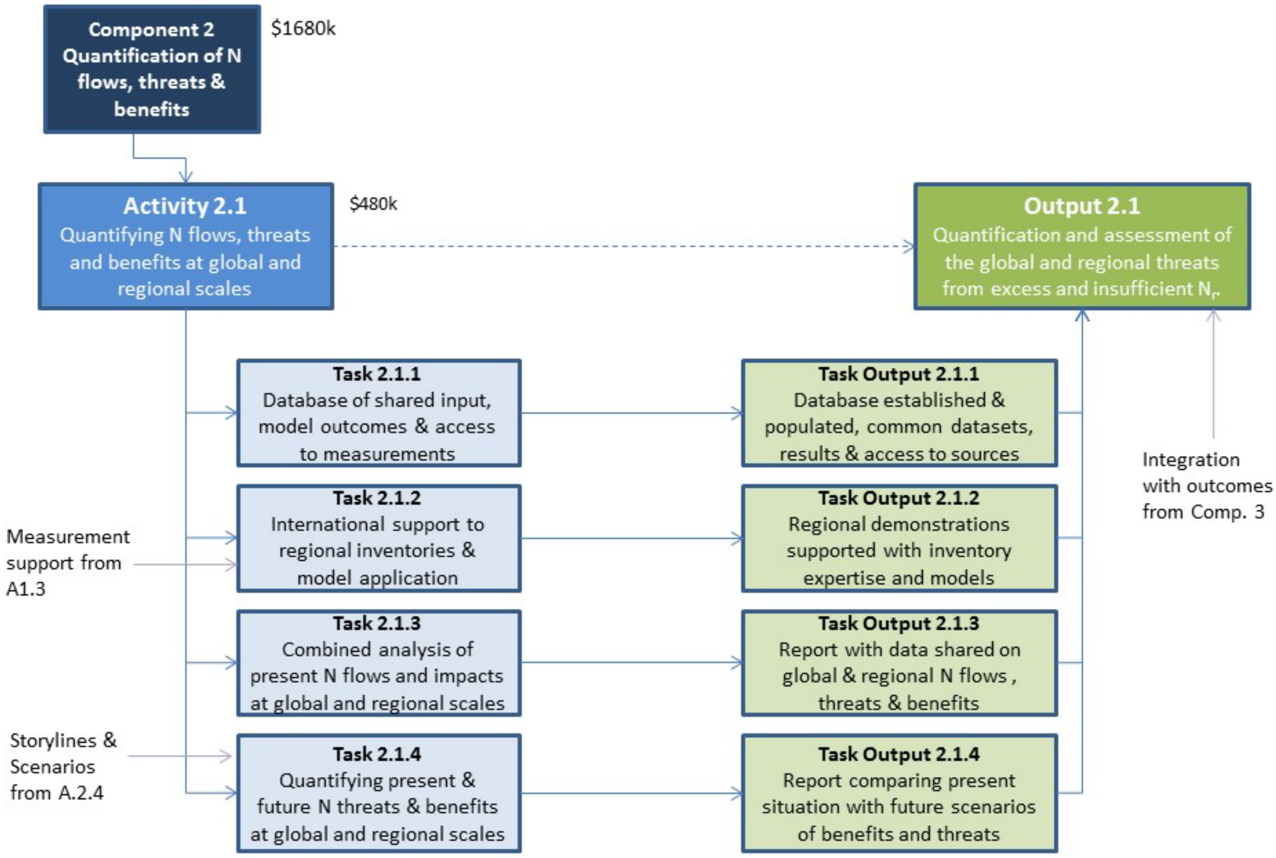

Figure A16.1: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation to quantifying nitrogen flows, threats and benefits (Activity 2.1; Output 2.1).*

The outcomes of Activity 2.1, will provide key material for the consolidated global assessment of N flows, pathways and effects in Component 2.

A large number of INMS partners have proposed to contribute to this activity including: ALTERRA- (The Netherlands), CCST-INPE (Brazil), PIK (Denmark), FAO - AGA (International), JRC (EU), NERC (UK), ZJU (China), UGENT (Belgium), BFU (China), RRes (UK), LA UMR 5560 (France), ISSCAS (China), AU ENV (Denmark), SRI (Russia), MET Norway (Norway), EPA (USA), ECN (The Netherlands), INRA (France), IIASA (Austria), UoY (UK), ARI (Russia), PBL (The Netherlands), CAU (China), RIVM (The Netherlands), NANC (US), ILRI (Kenya), 'New Energy' (NGO, Ukraine), VU (The Netherlands), UED (UK), CARR (China), LVBC (Uganda), NIES (Japan), ASU (Lithuania), IFA (France).

IIASA (Austria) and ATB (Denmark), ALTERRA (The Netherlands), INRA (France) have also expressed interest to provide advice and review the work.

Task 2.1.1: Database of shared input, model outcomes & access to measurements

Task Output 2.1.1: Database established & populated, common datasets, results & access to sources

Task Co-leads: William Bealey (PCU, NERC, UK) and Jean Ometto (CCST-INPE, BR)

The key role of this task is to establish an accessible resource that allows coordinated access to datasets used in establishing INMS nitrogen inventories, inputs to models and sharing of key results. The main users of this information are therefore modellers of the nitrogen cycle facilitating improved cooperation and harmonization and the regional demonstration activities. By sharing key results datasets the outcomes will also be useful to users of the data including for comparison with monitoring and in support of the regional and global assessment proceses.

The first steps will be to review the different information sources available and analyse their distribution between partners and external bodies. This will consider issues of data accessibility (ease access, language, complexity of permissions etc) and establish a datasources profile that can inform the next steps. The key decision that will need to be taken is to agree the optimal balance between accessibility and centralization versus utilisation of existing distributed data sources. For this purpose, the distinction will be made between developing the database portal in ain way that most effectively provides ready access to different datasets, which are actually stored elsewhere, and datasets that are actually stored in the INMS database. Technically, this will be delivered through two distinct tools. The facilitation of data coordiantion and access will utilize the ENCORE data cluster system established by NERC under the ÉCLAIRE project. Where it is necessary to store key datasets (as in key model outcomes developed by the project) these will be archived on a dedicated INMS database to allow ready access to partners.

Several INMS partners have established expertise in this area, including NERC (UK), INBE (Brazil), PIK (Denmark), WUR (The Netherlands), PBL (The Netherlands), FAO, NIES (Japan), JRC (EU), IIASA and UNECE, which will be utilized to help develop the data strategy.

Task 2.1.2: International support to regional inventories & model application

Task Output 2.1.2: Regional demonstrations supported with inventory expertise and models

Task Co-leads: Howard (PCU, NERC) and Jean Ometto (CCST-INPE)

This task allows partners of Towards INMS to share expertise across the project, especially in the development of methods for inventory development and model application. The task can also be useful for sharing expertise on nitrogen measurement methods, especially in linking up between air, land and water parts of the nitrogen cycle. The main focus will be to support sharing of expertise between INMS partners leading in their respective fields within the INMS Regional Demonstrations (Component 3), with funds used to build partnerships.

The work will be developed in three stages. Firstly, the description of this task will be expanded and presented to the first Project Partners Assembly, with a propose set of priority criteria and topics areas for likely support.

It will be up to the Project Partners Assembly to inform in case relative priorities should change. A starting position on criteria for prioritizing support is as follows: a) internationally leading sharing of expertise, b) a specific request for support from an INMS regional demonstation, c) first priority to N inventory and model development, but cases for sharing of measurement methods also to be considered.

Based on this confirmation, a call for short term misssions will be announced, and a short application form developed. It is anticipated that the application form should include:

- Name of the requesting INMS demo region, name and coordinates of the lead person requesting;
- Name of the INMS partner organization to undertake the mission;
- Name of the INMS partner expert to undertake the mission;
- Title of the mission;
- Short description of the purpose of the mission;
- Short description of the anticipated outcomes;
- Amount of grant requested;
- Short statement by receiving INMS demonstration region of its interest to host the mission;
- Applicant’s confirmation of agreement to deliver the mission report by a set date.

Requests for preparatory engagement from candidates for future INMS demonstration regions may also be considered. It is anticipated that the Task leaders will involve selected other INMS Partners and members of the Science and Policy Advisory Group (SPAG) to support the review process. It is anticipated that deadlines for applications may be set, with calls during Year 1, Year 2 and Year 3.

Task 2.1.3: Combined analysis of present N flows and impacts at global and regional scales

Task Output 2.1.3: Report with data shared on global & regional N flows , threats & benefits

Task Co-leads: Wim de Vries (WUR, NL) and Marine (tba)

This activity will focus on bringing together the different model components to deliver an overall analysis of nitrogen flows and impacts for present day conditions. It will build on the review of available models and model development activities of Component 1, encouring wide involvement from different groups.

For this purpose, agreement will be reached during the project inception phase on the best-suited base year, for which comprehensive datasets are available. It is ancipated that each of the main N flows, environmental compartments, and effects identified in Component 1 will be addressed using the agreed model cluster. It will be left open to the results of Activity 1.5, and subsequent confirmation with the Project Management Board (PMB) and Project Partners Assembly (PPA), how the model cluster should look for this purpose. This is because a balancing act will be needed that addresses the necessary comprehensive approach, while recognizing that the GEF contribution to Towards INMS only provides a fraction of the necessary costs. Conversely, the substantial co-financing contributions may enable the combined analysis to include comparison of several models for parts of the nitrogen cycle, thereby increasing robustness of the outcomes.

A close link is envisaged between this activity and the preparation of the consolidated global assessment of nitrogen fluxes, pathways and impacts. It is therefore expected that as the overall synthesis effort under Activity 2.2 develops, it will feedback to identify priority recommendations for Task 2.1.3, as well as specific requests for ways to visualise the outcomes.

To support this process, the report for this task will provide material to stimulate feedback from the PPA and the Stakeholder and Policy Advisory Group (SPAG), on how this may be best presented, e.g. as specific chapters in the overal global assessment of Activity 2.2.

Task 2.1.4: Quantifying present & future N threats & benefits at global and regional scales

Task Output 2.1.4: Report comparing present situation with future scenarios of benefits and threats

Task Co-leads: Wim de Vries (WUR, NL) and Marine (tba)

Based on the global scale modelling of N flows, threats and benefits for present conditions (Task 2.1.3) the approach will then be extended to address key global scenarios of possible future conditions. This will be informed by Activity 2.4 which will work to develop future nitrogen storylines and scenarios. While the focus of Activity 2.4 will be on envisioning different possible future outcomes and what might be needed to get there in broad terms considering the scale of the major drivers and the possible measures, including the possibilities for behavioural change by citizens, the focus of Task 2.1.4 will be to translate these into model runs that can best describe these scenarios.

Issues on data availability and model complexity will be used to inform the dialogue between these two activities, with input from the PPA and SPAG being used to help clarify the prioritities for future scenarios (advice on choice of years, connection with other processes) and importance of different change options. Bearing in mind the balance of these issues (resources, versus ambition, versus advice on priorities) agreement will be reached on which future scenarios could be carried through to full application by the INMS model cluster.

As with the previous task, the report from Task 2.1.4 will provide the opportunity to encourage feedback from the PMB, PPA and SPAG, with advice on issues to consider when summarizing the work for the global assessment of Activity 2.2.

2.4.2 Activity 2.2: Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations

Output 2.2 Detailed overview of regional/local N flux and consolidation into a global assessment of N fluxes, pathways, effects and benefits of improved N management

Activity Co-Leads: INI (Sutton and Howard, PCU, NERC).

The different steps in this activity are summarized visually in Figure A16.2. These include preparing the scope and structure of the consolidated assessment, commissioning lead author teams and preparing chapter drafts of the consolidated overview, peer-review of the chapters and revision, preparation of summary documentation supported by a specific review workshop, and finally publishing and disseminating the consolidated assessment.

This activity is an important one for the INMS process as it provides a key vehicle to present and synthesize the main achievements of Towards INMS to a global audience. The synthesis process will also allow the key messages to be refined, which will provide the underpinning material to support INMS communication and awareness raising in Component 4. Experience of the Project Coordination Unit (PCU) with other such processes, including the European Nitrogen Assessment and the Global Overview on Nutrient Management – ‘Our Nutrient World’, has shown that such consolidated syntheses have a huge power to communicate on the global stage. In this way, media engagement can stimulate public awareness and policy initiatives, which in turn feed back to develop future opportunities in international mobilization faciliating changes in practice on the ground.

The very process of preparing such a synthesis is also expected to stimulate new ideas in the targeted research itself. For example, the process of identifying key parts of the global report and its potential chapters typically results in other topics/issues being identified where there is currently insufficient attention. This process may lead to a proposal to amend the INMS work plan, so as to address these new priorities. For this reason, and also given the time taken to prepare such a global synthesis, it is planned that the process will kick off at the start of Towards INMS and run through its full duration.

While this activity is led directly by the PCU, it is expected that it will draw on all the Components and Activities. Specifically, it is planned that Component Leaders will play a key role together in coordinating this process, drawing inputs from other INMS partners. The PCU will make a first proposal as to overall structure to the Component Leaders, Implementing Agency and Executing Agency (together the PMB) for revision and presentation to the SPAG and PPA. This will then support a process of mapping of outputs of INMS Activties and Tasks into the global synthesis and, from this, the nomination of lead and contributing authors.

In this way, it is anticipated that a first outline concept of the consolidated global assessment will be produced during Year 1 of Towards INMS for review and adoption by the PPA. This will then allow a more detailed mapping of chapter responsibilities in Year 2. The actual drafting would be conducted in Year 3, with final outcomes included during Year 4 (especially where these are not planned to be ready earlier). Finally, peer review and finalization of summarizes and production will be made during Year 4. Subject to confirmation of the proposal on timing and strategy by the Implementing Agency (UNEP) and the PPA, it is proposed to launch the product as part of the final INMS conference at the end of Year 4.

This Activity will draw on **contributions from across the INMS partnership**, including all four components. Component and Activity leaders will play a key role in supporting the process, with specific chapters anticipated on the different INMS Regional Demonstrations. In addition to core writing by science experts, contributions and advice from SPAG members will be encouraged.

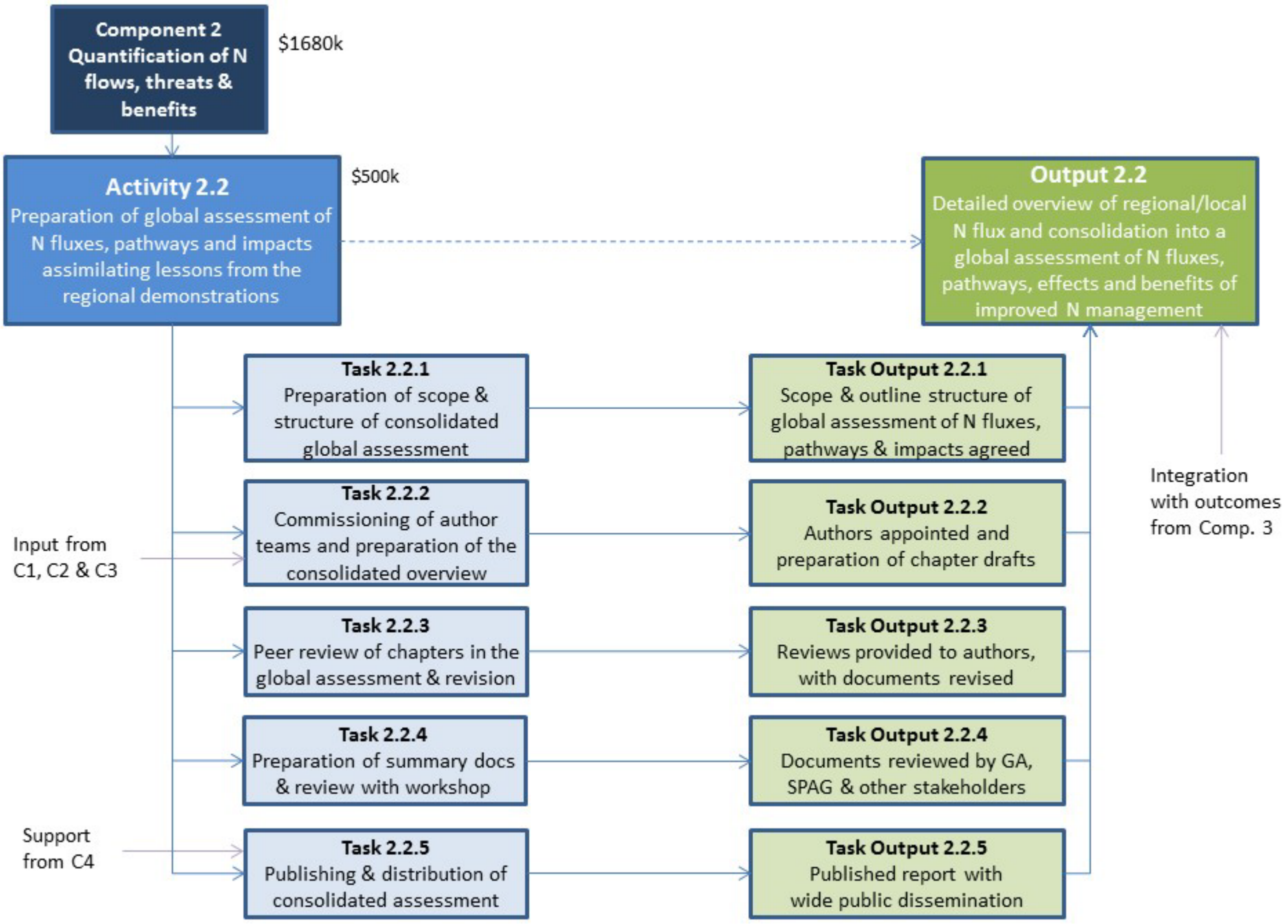

Figure A16.2: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation to preparation of global assessment of N fluxes, pathways and impacts (Activity 2.2; Output 2.2).*

A number of INMS partners have proposed specifically to contribute to this activity, including: NERC (UK), ALTERRA (The Netherlands), ILRI (Kenya), UGENT (Belgium), IIASA (Austria), FAO AGA (International), INRA (France), RRes (UK), PIK (Germany), PBL (The Netherlands), JRC (EC), ECN (The Netherlands) and VU (The Netherlands).

Task 2.2.1: Preparation of scope & structure of consolidated global assessment

Task Output 2.2.1: Scope & outline structure of global assessment of N fluxes, pathways & impacts agreed.

Task Co-Leads: INI (Sutton and Howard, PCU, NERC).

During year 1 of the project, a first outline concept of the global assessment will be prepared by the INMS Project Coordination Unit, which will aim to achieve the following elements: a) Addresses the core challenge of why a cross-cutting approach to the nitrogen cycle is relevant, clearly summarizes the baseline and explains the overarching framing of the sections that follow, b) addresses the nature of the key sources of nitrogen and their drivers, c) addresses the pathways of nitrogen and its interconversion between different N forms at different temporal and spatial scales and how this has relevance for consequences, d) addresses the major impacts of human alteration of the nitrogen cycle, including the multiple benefits and threats, e) addresses current and emerging options for improved management of the nitrogen cycle, including examination of future storylines and scenarios, and possible vehicles for change (through communication, policy, practice etc), f) illustrates these challenges and possible solutions, including success stories, by reference to a series of major case studies for different world regions, drawing on the INMS regional demonstrations, g) synthesizes the key drivers, needs, barriers-to-change and options for overcoming them. These elements might contribute major parts of the final product, which would then be used to prepare technical and executive summaries for wider distribution.

The draft scope and outline will be reviewed initially by the PMB, for sharing with the PPA and SPAG as a basis for providing a revised version to be agreed by the PPA. At the same time, material will be provided summarizing the process for the next steps to be agreed by the PPA.

It is expected that there will be a close link between Component Leaders and editors of the consolidated global assessment. In the process of undertaking this activity, it is anticipated that there may be important feedback to other activities, especially A2.1, A2.3 and A2.4. For example, this may include identification of critical factors, caveats and emerging trends.

Task 2.2.2: Commissioning of author teams and preparation of the consolidated overview

Task Output 2.2.2: Authors appointed and preparation of chapter drafts

Task Co-Leads: INI (Sutton and Howard, PCU, NERC).

Based on agreement of the overall approach and process by the PPA, this Task will focus on preparing the coordination team for the consolidated overview, including identification of lead and contributing authors to different chapters. The PCU will particularly draw on advice and inputs of the Component and Activity leaders and provide a means for all INMS partners to offer their input. Proposals will be tested with support from the SPAG, as a basis for agreement by the PPA. This will then allow the PCU to commission author teams, setting out a) the scope and objectives of each commissioned section, b) the necessary elements to be consdered, including *problematique* and kinds of information to be included, c) issues of common style and format, d) timetable and review process. As far as possible, authors will be requested to indicate degree of confidence/uncertainty in their conclusions and key messages.

It is expected that the actual process of preparing chapters and sections of the consolidated global assessment will take place as part of the work of the different Activities and Tasks of INMS, which is also serving to focus on ensuring that key higher-level outcomes are achieved.

Task 2.2.3: Peer review of chapters in the global assessment & revision

Task Output 2.2.3: Reviews provided to authors, with documents revised

Task Co-Leads: INI (Sutton and Howard, PCU, NERC).

This task will manage the peer review process of the draft chapters, ensuring that the material meets a leading international scientific standard. Reviewers may be selected from within as well as outside of INMS and depending on the nature of a chapter, may include both scientific review and expert review from policy and practice stakeholders. Task 2.2.1 will yield both a list of authors and potential chapter reviewers. The list of possible reviewers will be extended to include other international experts from beyond the INMS community to ensure full independence of the review and a high standard. Peer reviewed chapters will be returned by the PCU to lead authors for revision under an agreed timescale. Authors will be required to amend chapter drafts and provide a summary of the changes they have made, so that the editors can make a decision whether further review and revision is necessary. Each chapter will include a short summary of key messages, which will be checked for consistency with the evidence provided in the chapter. This will allow authors to prepare revised versions for submission to the PCU.

Task 2.2.4: Preparation of summary documents & review with workshop

Task Output 2.2.4: Documents reviewed by PPA, SPAG & other stakeholders

Task Co-Leads: INI (Sutton and Howard, PCU, NERC).

The finalized chapters will be used to prepare summary documents of the overall consolidated assessment, with input from the PPA, SPAG and other stakeholders. It is anticipated to include two forms of summary, one focused more at policy makers, and one focused more at a technical and scientific audience. However, this proposal will be reviewed before a final decision is taken. The draft summary(s) will be prepared by the PCU with the support of other editors and experts. The final summary will then be opened for review by the PPA, SPAG and stakeholders, which will be used to finalize the document.

This process will also need to manage the possibility of divergent views and stakeholder positions, especially given that the SPAG includes stakeholders with different views. It may therefore not be possible to produce a consensus document that satisfies every stakeholder. In this regard, it shall be declared that the consolidated assessment expresses the opinions of the experts listed as authors, according to the authorship of each chapter / summary (not their organisations), while the chapters / summary will seek to capture the esssence of different arguments where as far as this is necessary to make the outcomes clear.

Task 2.2.5: Publishing & distribution of consolidated assessment

Task Output 2.2.5: Published report with wide public dissemination

Task Co-Leads: INI (Sutton and Howard, PCU, NERC).

Negotiations will be entered into with leading publisher(s) to maximize the public dissemination opportunity of the global consolidated assessment. Outline discussions have already been had with Cambridge University Press, who have indicated their enthusiasm to publish the product on behalf of INMS, INI, UNEP and GEF. However, the merits of other altenatives will need to be considered before a final decision is taken. The PCU envisages the consultation with the PMB, PPA and SPAG under Task 2.2.1 will also include feedback on the choice of publisher to maximize global impact.

This task will then cover the process of publishing the consolidated assessment, including submission of final texts and artwork, layout, preparation of proofs, checking with authors, finalisation and distribution itself. This will provide material for action in Component 4 to develop further communication and dissemination approaches, including with press and other media.

As part of this task, ongoing discussions will continue on the relationship of this INMS/INI/UNEP process to other international assessment processes, in particular IBPES and IPCC. There may be advantages to link these processes, but the timing and arguments need to be further evaluated.

2.4.3 Activity 2.3: Integrating methods, measures & good practices to address issues of excess & insufficient reactive nitrogen

Output 2.3: Consolidation of methods and good practices to address issues of excess and insufficient reactive nitrogen

Activity Co-Leads: TFRN / EU Nitrogen Expert Panel (Oenema, WUR) and TBA

At present guidance for good management of nitrogen tends to be fragmented between different forms of nitrogen and different issues. In order to fully exploit the synergies that operate through the nitrogen cycle, and to avoid trade-offs that can also result from the biogeochemical linkages, there is a pressing need to develop consolidated guidance on methods and good practices. Such methods and good practices can be relevant in both areas of excess N (reducing pollution threats) and in areas of insufficient N (making use of limited available resources). In fact, both issues apply in both cases: N losses still contribute to pollution even in areas of insufficient agricultural N, while the improving resource use can offer substantial financial benefits in areas of excess N.

This Activity complements the global synthesis of Activity 2.2 as well as contributing to it. Its purpose is more technical, focusing on reviewing and integrating detailed descriptions of management guidance for parts of the nitrogen cycle into a comprehensive whole. The starting point is to gather different existing published sources on good practice guidance, also drawing on the Tool developed as part of the UNEP/GEF Global Nutrient Cycles Project, which is a part of the Global Partnership on Nutrient Management. Such documents have been prepared by many bodies and range from the summary guidance of UNEP (2013) in "Drawing down N_2O" to detailed descriptions of water pollution by national bodies such as US EPA and the European Union, to comprehensive listing of the options for reducing ammonia emissions in the UNECE Ammonia Guidance Document. The challenge is to bring these together, while reviewing emerging technologies and approaches, to prepare more synthetic guidance that highlights the win-wins-wins for food production, soil, water and air quality, climate, biodiversity, and energy.

Particular attention needs to be given to the better management of nitrogen in agriculture (fertilizer and manures including issues linked to biological nitrogen fixation where relevant). However, the activity needs to consider all possible sources of N where better management practices can be developed to reduce adverse effects and offer improved access to the benefits of nitrogen. Therefore it is anticipated that the activity and prepared guidance will also include sections on reducing (and especially recapturing and recycling) NO_x emissions, as well as recycling other N resources such as from solid waste and waste water. **An overall philosophy to develop better nitrogen recycling approaches rather than denitrification approaches will be explored, especially how this can contribute to Green Economy and Circular Economy developments.**

The output will consist of a synthetic guidance document for wide dissemination to countries, international organisations, business and advisory services. In addition, it is expected that the key messages will be incorporated as a specific chapter or chapters in the consolidated global assessment (Activity 2.2). Thirdly, the document will be useful as a key resource to support wider dissemination in Component 4, such as through the identification of a "nitrogen top-ten": identifying the top ten actions for better nitrogen management, which can be useful for countries, business and civil society.

INMS partners who have proposed to contribute to this activity include: ALTERRA with WU (The Netherlands) , NERC (UK), ENEA (Italy), University of Aarhus (Denmark), ISA (PT), BBRI (India), CAU (China), UNECE, RRes, IARI (India), WRI (US), ISSCAC (China), ECN (The Netherlands), INRA (France), UoY (UK), CIMMYT, ADEME (France), ARI (Russia), PBL (The Netherlands), North American Centre of INI, NANC (including collaborative stakeholder programme on Agriculture Committee of Rocky Mountain National Park), ILRI (Kenya), FAO AGA (International), VU (The Netherlands), ATB (Denmark), JRC (EU), Fertilizers Europe (Europe), ENEA (Italy).

The following are anticipated to contribute advice and as reviewers: WUR LR (The Netherlands), PCH (Spain), DETJTR (Australia), AgResearch Ltd (New Zealand). As this activity develops the core teams will work to include other areas of expertise in this activity so as to widen its relevance and eventual impact. This will also allow the activity to profile new innovations in its activity.

Task 2.3.1: Preparation of documents on state of the art for best nitrogen management practices

Task Output 2.3.1: Background documents produced & available for workshop input

Task Co-Leads: Oenema (WUR, NL) and tba

The first task of this activity is to gather material that is already available on good management of different parts of the nitrogen cycle for different impacts. The information to be gathered should cover the following sectors and the following issues.

With regard to sectors, particular attention will be given to collecting management guidance on agriculture (including cropping systems, manure management, soil management and livestock management). In addition, attention will also be given to management in later parts of the food chain (although subject to agreement, this is not expected to include households and citizens choices which are addressed in Activity 1.6). Attention will also be given to other sectors including current guidance for reducing NOx emissions and the potential to develop NO_x recycling opportunities, as well as recycling of nitrogen in solid wastes and waste water streams.

With regard to impacts, available guidance will be brought together as this links to all major impacts of N losses including effects on water quality (freshwater and marine), air pollution, greenhouse gases and economic effectiveness for sectors. For the latter, this implies the inclusion of measures that not only reduce reactive nitrogen losses, but also losses of denitrification to N_2, given the substantial product value (i.e. fertilizer and other value) of N losses.

It should be emphasized that it is not the role of this task to address these different impacts and issues, which are being addressed elsewhere in Towards INMS. Rather, this task needs to take account of each of these issues in developing joined up guidance for good nitrogen management.

This task will simultaneously work to further build the international Community of Practice in good nitrogen management methods, bringing together experts from different areas of expertise. It will be supported in this regard by dissemination activities in Component 4.

The task will lead to the preparation of a group of background documents which can stimulate discussion on these issues. In particular, it will stimulate a first concept of how a future joined up guidance document for nitrogen management should look, and to which policy frameworks it would be linked (e.g. UNEP, UNECE, CBD, GPA, FAO etc).

Task 2.3.2: Workshop to link methods & good practices for N effects (food, water, air, climate etc)

Task Output 2.3.2: Basis for developing guidance linking N forms & issues, high-lighting most promising options

Task Co-Leads: Oenema (WUR, NL) and TBA

The workshop will bring together experts in a wide range of disciplines relevant to reducing nitrogen losses and promoting good practices to minimize the adverse effects of nitrogen and to maximize the co-benefits, for economy, environment, food and health etc. The discussion will be informed by presentation of the background documents, and a proposal made for how the joined up guidance should look.

The proposal, including the vision, scope and outline structure will be provided to the PMB and SPAG for their comments, and then submitted to the PPA for amendment and agreement on the approach.

Note that it may be possible to structure this as two workshop (a, wider scoping and b, more detailed review) which will also facilitate close engatgement with SPAG and PPA. Whether it is possible to do this in two steps will depend on the potential for synergies with other workshops (e.g. back-to-back approach) and the potential for drawing in additional cash co-financing.

In parallel, it is expected that the concept document be shared in the relevant policy domains where it can contribute simultaneously, for their feedback and to foster their engagement in the process. This will include regional conventions/programmes linked to the INMS demonstrations, e.g. UNECE (LRTAP and Water Conventions; European Union; Black Sea Commission, Danube River Basin Commission; South Asia Cooperative Environment Programme (SACEP), PEMSEA, LVBC; La Plata River Basin Commission etc.), as well as global processes including UNEP, CBD, GPA, GPNM, FAO, IPCC, Vienna Convention (Montreal Protocol), WHO and WMO.

In this way, this process will foster engagement in the developing concept of a 'nitrogen policy arena' in cooperation with Component 4.

Task 2.3.3: Publishing of revised papers and preparation of synthesis guidance document

Task Output 2.3.3: Workshop report, with guidance document synthesized for wide review

Task Co-Leads: Oenema (WUR, NL) and TBA

Based on the workshop report and wider stakeholder feedback the background documents will be used as a basis to prepare sections/chapters to a draft guidance document. This will provide a first version of the draft guidance document on joined-up nitrogen management, which can then be provided back to stakeholders (as listed above) for their review.

Task 2.3.4: Peer and Stakeholder review of Synthetic N guidance document

Task Output 2.3.4: Text of consolidated guidance document finalized

Task Co-Leads: Oenema (WUR, NL) and TBA

It is anticipated that the process of review of the guidance document may need to be conducted in an iterative fashion. This is because the timing of different stakeholder feedback may be hard to constrain into a narrow period of time (e.g. if other policy processes are operating on dfferent process timescales). Nevertheless, a review period will be set in which partners of Towards INMS, stakeholders, and wider policy processes (listed above) will be invited to send their comments, so as to conduct the revision in a timely fashion. It will be noted where other policy processes are anticipated to provide planned further recommendations and inputs at a later stage, specifying which timing is anticipated and which process this links to. This will be important to set the final document from this round (First edition of the UNEP/INMS Nitrogen Guidance) in context and anticipate in advance what future revisions will be necessary under future projects (after 'Towards INMS').

Any issues on difference of strategy or position will be referred to the PMB and SPAG for their advice, with the final document presented to the INMS PPA for its adoption.

Task 2.3.5: Publishing of synthesis document & updating of practice database

Task Output 2.3.5: Consolidated methods/practice report & database published

Task Co-Leads: Oenema (WUR, NL) and TBA

It is anticipated to publish the results of the guidance in two forms. Firstly, the main synthesis document will be pubished as a key INMS output for wider dissemination. This will be supported with a publication budget managed under Activity 4.5. Secondly, the material will be incorporated into the INMS database. It is anticipated that this database will take as a starting point the Tool Box of measures developed under the GEF/UNEP GNC project. However, it may also be relevant to reap the benefits of other similar databases that are identified in the process of conducting Activity 2.3, especially in developing links though the emerging 'nitrogen policy arena' with different policy processes as users of the information.

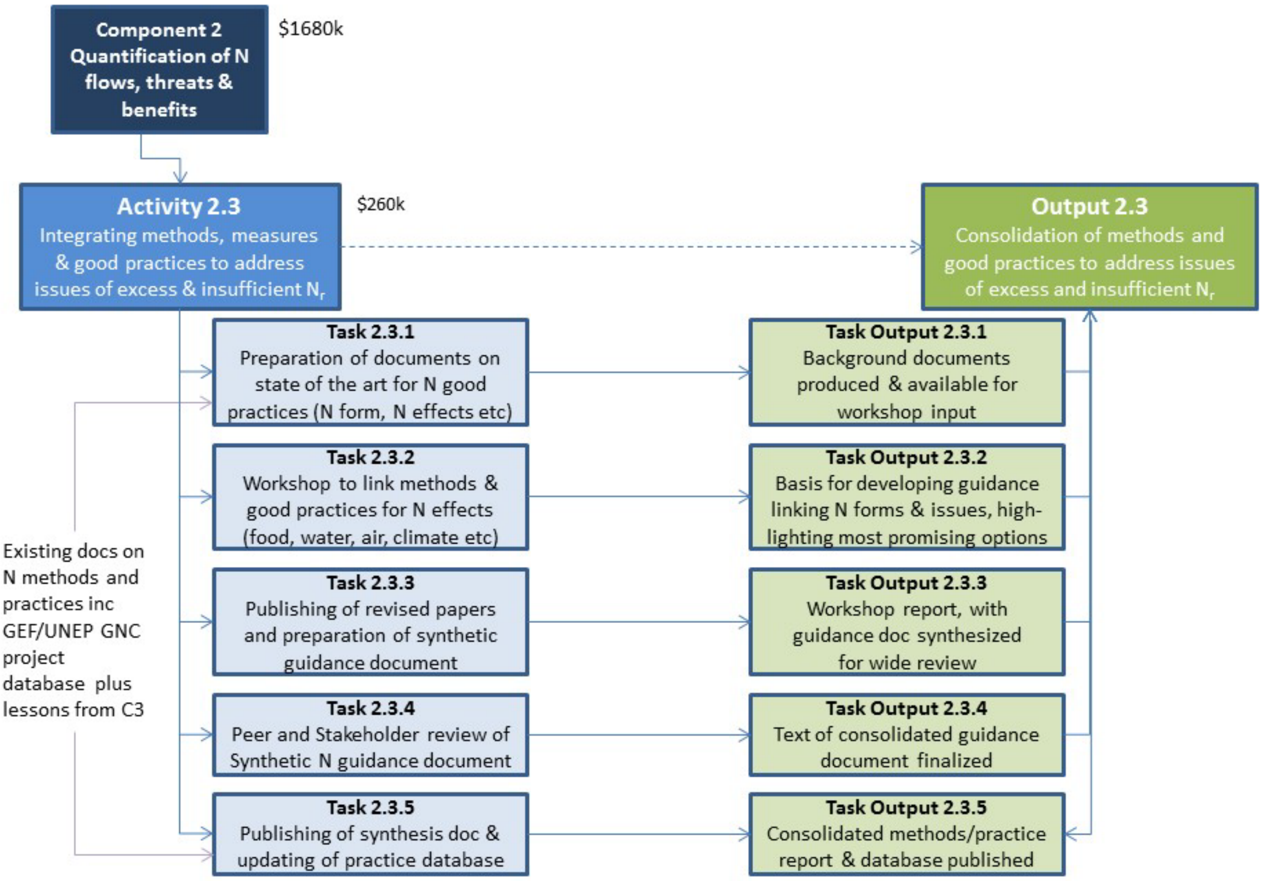

Figure A16.3: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation to integrating methods, measures and good practices to address issues of excess and insufficient reactive nitrogen (Activity 2.3; Output 2.3).*

2.4.4 Activity 2.4: Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis

Output 2.4: Definition of programmes & policy options for improved reactive nitrogen management at local/regional/global levels, supported by cost-benefit analysis to underpin options for the Green Economy

Activity Co-Leads: INI Europe / TFRN (Winiwarter, IIASA) and INI North America / SDSN (Kanter, New York University)

The purpose of this activity is to examine how the global nitrogen cycle may alter in the future and what the consequences of this future change would be. For this purpose, broad storylines will be considered to frame possible futures, as well as specific scenarios of 'what if' considered.

The starting point will be a review of existing nitrogen policies for different regions and countries, examining what policies they have in place and how these link to the nitrogen cycle, the extent to which synergies across the nitrogen cycle are addressed, and the extent of gaps. This first task will serve a dual role to inform the storyline and scenario development, but also to inform the interaction with international policy processes in Component 4.

In considering possible future storylines, attention will be given to current thinking on storylines in other domains, including those from food production, climate, air, biodiversity and water communities. For example, the Special Report on Emission Scenarios[21], earlier used four main storylines (A1, B1, A2, B2) to characterize different possible futures, which subsequently informed the storylines of the Millenium Ecosystem Assessment[22]. In turn, later work on climate has considered Representative Concentration Pathways (RCP, linked to a certain degree of radiative forcing)[23] and Shared Socioeconomic Pathways (SSP)[24]. These examples will need to be considered in relation to scenario approaches used by the transboundary water and air pollution communities and specifically their impact on nitrogen compounds[25,26,27]. Similarly, an emerging narrative is that of 'planetary boundaries'[28],[29], and it will be examined to what extent this framing can be useful for analyzing the challenges of too much and too little nitrogen.

In considering future scenarios, the link will be made with what are often called 'business as usual' scenarios, considering how this relates to particular storyline development. This may illustrate, what would happen if no active changes are made to the way nitrogen is managed in the world, i.e. the consequences of no further action. This will be contrasted with what might be achieved by different actions, including through technical measures in different sectors and through societal changes. This first of these may include water and air pollution mitigation technologies (emission reduction focus) as well as strategies to improve nitrogen use efficiency (green and circular economy focus), as these are relevant in e.g. arable agriculture, livestock production, combustion processes and waste water treatment. The second of these may include the effect of different future human populations, consumption choices related to the mix of food and energy types, and human choices on domestic waste. While it will necessarily be impossible to address every interaction in detail, a key part of the work will be to identify a) which measures / actions offer the major opportunities for change (reducing adverse effects of N and improving the retention of N benefits) and b) how these may be be grouped into distinct classes of action, c) where there is potential for synergy across the nitrogen cycle (in cooperation with Activity 2.3) and d) what are the priority measures that need to be incorporated into global and regional models describing scenarios of the future nitrogen cycle.

It is anticipated that particular attention will be given to key future years, such as 2050 and 2100. However, the decision on how much to focus on these years or other years, will need to be made based on the review of existing available scenarios from existing processes as these link to different aspects of the problem (e.g. climate, water, air, biodiversity) and the opportunity (e.g. food and energy supply). It is important to

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[21] Nakicenovic, N. et al . (2006). Special Report on Emissions Scenarios. Working group III of the Intergovernmental Panel on Climate Change , Cambridge University Press, Cambridge, UK, 2000.

[22] Carpenter, S.R., Pingali, P.L., Bennett E.M., Zurek, M.B. (eds.), 2005. Ecosystems and Human Well-Being: Scenarios , Volume 2, Findings of the Scenarios Working Group, Millennium Ecosystem Assessment . Island. Press, Washington DC.

[23] van Vuuren, D.P., et al. (2011) The representative concentration pathways: an overview. Climatic Change 109, 5–31. doi:10.1007/s10584-011-0148-z.

[24] Nakicenovic, N., Lempert, R.J., Janetos, A.C. (2014) A Framework for the Development of New Socio-economic Scenarios for Climate Change Research: Introductory Essay. *Climatic Change* **122**, 351–361. doi:10.1007/s10584-013-0982-2.

[25] Bouwman, L., et al. (2013) Exploring global changes in nitrogen and phosphorus cycles in agriculture induced by livestock production over the 1900–2050 period. PNAS 110, 20882–20887. doi:10.1073/pnas.1012878108.

[26] Bodirsky, B.L., et al. (2014) Reactive nitrogen requirements to feed the world in 2050 and potential to mitigate nitrogen pollution. *Nature Communications* **5**. doi:10.1038/ncomms4858.

[27] Winiwarter, W., et al. (2013) Estimating environmentally relevant fixed nitrogen demand in the 21st century. *Climatic Change* **120**, 889–901. doi:10.1007/s10584-013-0834-0.

[28] Rockström, J., et al. (2009) A safe operating space for humanity. *Nature* **461**, 472–475.

[29] Steffen, W., et al. (2015) Planetary boundaries: Guiding human development on a changing planet. *Science* 1259855. doi:10.1126/science.1259855.

emphasise that these scenarios will need to consder both the benefits of nitrogen and the threats, and both areas with excess and insufficient reactive nitrogen.

INMS partners who have proposed to contribute to this activity include: IIASA, New York University (US), PIK (Germany), PBL (The Netherlands), OECD, FAO, UNEP, CBD, UNECE, ZJU (China), WRI (US), CARR (China), ECN (The Netherlands), UoY (UK), ADEME (France), AU ENV (Denmark), ISA (PT), VU (The Netherlands), NERC (UK), JRC (EU).

The following propose to contribute advice and to act as reviewers: INRA (France), PCH (Spain), RIVM (The Netherlands), IFA.

Task 2.4.1: Review of existing N policies for different countries & regions

Task Output 2.4.1: Report with database as input to workshop on N policies, storylines & scenarios

Task Co-Leads: Bonnis (OECD), Kanter (New York University)

This task will serve to bring together information on policies linked to nitrogen in different regions and globally. For this purpose the work will connect directly with the policy initiatives of countries, engaging closely with the programme in this area of OECD, but also extending this to other key INMS countries beyond OECD. To do this, the policy review approach questionnaire of OECD will be reviewed at the start of the project, and modified as necessary considering other regional/national needs. This will then be shared with partners in the INMS Regional demonstrations to support their engagement with national governments and regional environmental agreements. The collected information will be used firstly to create a simple database, allowing others subsequently to add information, which will be developed in partnership with the PCU. Secondly and more importantly the information will be synthesized to provide a better understanding of the gaps in policies, extent of synergies and trade-offs, and to explore possible routes by which a stronger gravity for action can be developed by joining up across the nitrogen cycle.

The first review will feed as a background document to the INMS workshop on storylines and scenarios, which will then inform the next steps on priority for this work. Depending on the acquisition of additional external resources this work may be extended to consider how the planetary boundary approach could be more closely linked into future policy development for nitrogen.

Depending on the availability of additional resources, this task may also go further in analysing the experience of different policy instruments linked to nitrogen. The starting point will be information collected from the country case studies, which can then be used to synthesize information on the opportunities, strengths, limitations, etc, of different policy instruments.

Task 2.4.2: Review of existing storylines and scenarios relevant for N

Task Output 2.4.2: Document as input to workshop on N policies & scenarios

Task Co-Leads: Winiwarter (IIASA) and Kanter (New York University)

This task will provide the basis to prepare for a workshop that brings together different views on storylines and scenarios for nitrogen in relation to its multiple benefits (food, fibre, energy etc) and threats (water, air, greenhouse balance, ecosystems, soils etc), linking environment and health issues. The background document will seek to bring together the current status of different existing approaches to nitrogen scenario development on both regional and global scales. This dual focus is important given the multi-scale relevance of nitrogen, which links local and regional issues (e.g. water quality, air quality, biodiversity) with global issues (climate, trade, barriers, economy etc).

In preparing the background document, an initial compilation of existing scenario approaches and storylines will be shared with the contributors to Activity 2.4 in order to broaden the scope, integrate different aspects of individual focal areas and stakeholder groups and interests. At the same time, this allows dissemination of status information within the community in an early project phase. Specific contributors may be invited to provide elements of the background document once its scope has been defined as part of the initial compilation.

Task 2.4.3: Workshop on N storylines and scenarios for shared use across the project

Task Output 2.4.3: Published strategy for N storylines and scenarios

Task Co-Leads: Winiwarter (IIASA) and Kanter (New York Univesity)

The focus on this workshop will be to bring together those with expertise and current involvement in developing and applying future storylines and scenarios for nitrogen, while coming from many different perspectives. It is anticipated to include the latest thinking on scenarios linking nitrogen to climate (with links to current IPCC scenarios development, e.g. SRES, SSP and future), to air quality (e.g. LRTAP, US, EU, China, India scenarios), to water quality (scenarios from regional seas / waters conventions and programmes, including Black Sea, Baltic Sea (HELCOM), Mediterranean, East China Sea (PEMSEA), UNECE Transboundary Waters Convention, LVBC, La Plata River Basin Commission. Subject to further discussion and external resources it may also be possible involve also the Gulf of Mexico (Cartagena Convention).

In bringing the science and policy communities together for nitrogen, a vision will be developed for how synergies can be identified in future scenario development. The draft document will be reviewed by the Project Management Board (PMB) and the Stakeholder and Policy Advisory Group (SPAG) for adoption by the Project Partners Assembly (PPA), leading to the publishing of an INMS nitrogen scenarios strategy. This strategy will include among points, clear recommendations on the issues that need to be addressed in nitrogen strategies, the benefits from considering different nitrogen-related issues together in future strategies, and list of priorities for capability that needs to be included in models to address the most important future options (e.g. types of management and mitigation action in different sectors, opportunities related to food and energy choices etc.)

Drawing especially on Activities 1.4 (cost benefit analysis), 1.6 (barriers to change) and 2.3 (technical options and measures), this Task will work with Activity 1.5 and 2.1 to generate the agreed scenarios that will be used in the simulations of the INMS modelling cluster. It should be therefore clear that the modelling requirements of Activity 1.5 and 2.1 will need to be considered alongside the identified priority needs from the perspective of both scenarios (Activity 2.4) and possible technical measures (Activity 2.3).

Task 2.4.4: Synthesis of future programmes and policy options supported by scenario development and cost benefit analysis.

Task Output 2.4.4: Report on nitrogen policy options and their possible contribution to the Green Economy.

Task Co-Leads: Winiwarter (IIASA) and Kanter (New York Univesity)

As the activity develops in relation to future nitrogen scenarios across INMS, several future developments and opportunities will be expected. These can also be linked to the emerging development of the policy landscape, especially in the context of the 'nitrogen policy arena'. In this regard this Task will link closely with Activity 4.3 on international processes in order to inform the policy arena and to feedback to the development of supporting concepts and approaches.

This work will also link to progress in the Sustainable Development Goals (both development and implementation, as that process progresses), and to the development of processes linked to planetary boundaries, exploring how the planetary boundary concept can be refined for nitrogen and conversely how the nitrogen case could support the planetary boundaries approach.

Subject to additional external resources being obtained, a target setting approach to linking nitrogen scenarios to planetary boundary options may also be developed.

The output of this task will be a report on policy options, their relationship to future global economy and wellbeing, linking, for example, to the current state of concepts such as the Green Economy, Green Growth and the Circular Economy.

As an INMS technical document focused on policy analysis, it its not anticipated to be the role of this Task and its report to advocate specific solutions. Rather the focus is expected to be on understanding the consequences of different options, their implications and risks, as well as highlighting key opportunities. In this way, it is anticipated that the report will play an important role to stimulate discussion within the nitrogen policy arena (including countries, international conventions and programmes, business, civil society etc).

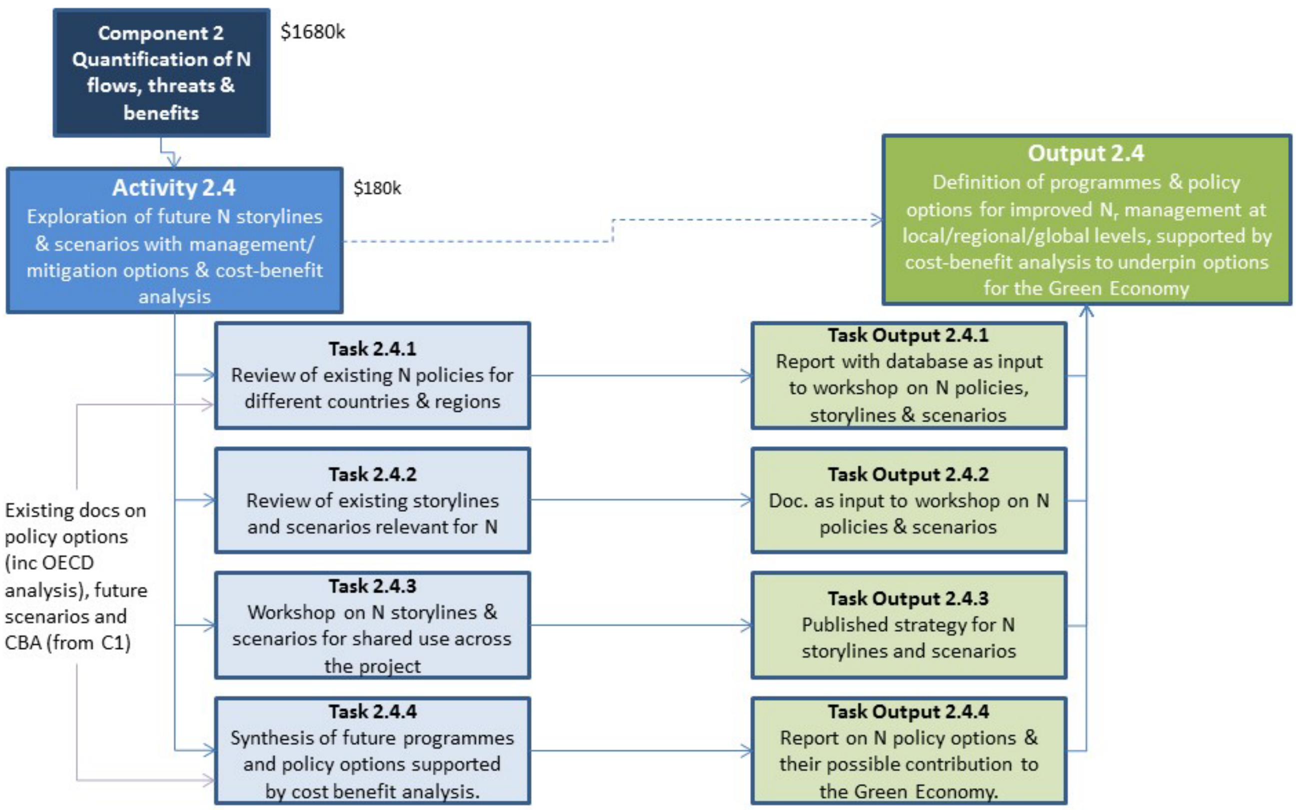


Figure A16.4: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation to exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis (Activity 2.4; Output 2.4).*

2.4.5 Activity 2.5: Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient reactive nitrogen

Output 2.5: Compendium summarizing the state of knowledge, experience and measures adopted by GEF (and others) gained from addressing the issues of excess and insufficient reactive nitrogen

Activity Co-Leads: GPNM (Walker, WRI, US) and INI (Bleeker, PBL, NL)

The aim of this task is to produce a compendium summarizing what has been achieved by GEF and others, including OECD, UNECE and other international and national programmes, through previous and ongoing interventions related to the nitrogen cycle. The focus here is not just on scientific underpinning and on policy development, but even more on achieving changes in practice, giving examples of success stories related to better nitrogen management that can be shared with a wider audience. This may include examples of demonstrating a new technological approach to improve nitrogen use efficiency or reduce N losses, the sharing of improved monitoring and awareness schemes (e.g. farm N budgeting, ecosystem health record card approach), demonstration of approaches to overcome barriers to change, and demonsttration of success stories that show improved environmental quality.

While the starting point will be a review of GEF actions, the analysis will also be widened by engagement through the INMS network, including the Regional Demonstration Partners to identify other examples for inclusion in the review. These will include examples of bi-lateral country pairing, where these can be identified and given more visibility through the INMS review and database.

This synthesis should not, however, only be an uncritical search for success stories. As the information is brought together, it is expected that common messages may emerge where barriers to change are not solved, where methods adopted are not sufficiently integrative (e.g. with risks of nitrogen pollution swapping) or where mistakes have been made that the INMS community needs to learn from. The aim here will be learn from this synthesis to see how stronger nitrogen approachces can be developed in future.

INMS partners who have proposed to contribute to this activity include: WRI (US), ECN (The Netherlands), OECD, Indian Nitrogen Group (India), ISA (Portugal), VU (The Netherlands), ATB (Denmark), NERC (UK).

The following are expected to offer advice and to act as reviewers: INRA (France), UBA (Germany), ADEME (France), PBL (The Netherlands), FAO AGA, LVBC (Uganda), UNECE, The Commission on the Protection of the Black Sea (BSC PS), UNEP.

Task 2.5.1: Review of N measures adopted by GEF and incorporation into database

Task Output 2.5.1: Database and summary document on GEF N measures

Task Co-Leads: Walker (WRI, US) and Bleeker (PBL, NL)

The first task will focus on bringing together information from past GEF projects as far as these link to the nitrogen cycle, but which can also be used for collection of information from other sources (e.g. GPA, OECD, CBD, LRTAP, GPA, CDM, Montreal Protocol and other regional conventions and programmes).

At the outset a form will be designed to gather information on measures that can form the basis for information collected in the database. The format will be designed by the Activity leaders in cooperation with the Component leaders and PCU. This will then be reviewed by the PMB and SPAG to get their feedback as a basis for finalizing the data collection structure. Although it is not proposed to present this database structure for a decision by the PPA, all partners (i.e. PPA members) will be invited to supply comments where they have an interest, at the same time as flagging up examples that they suggest be included in the database.

The starting work of Task 2.5.1 will allow the Activity Leaders to ensure that the database structure is finalized, and the database itself constructed. The data gathering process will then commence, simultaneously contributing to populate the database and to provide material for the compendium. In cooperation with the PCU it is anticipated to make this database available on the INMS website. A summary document on measures adopted by GEF will provide an output to share with the PMB, SPAG and PPA.

Task 2.5.2: Review of N measures adopted by others including from INMS demonstration regions and inclusion into database

Task Output 2.5.2: Database and summary document on N measures adopted by others

Task Co-Leads: Walker (WRI, US) and Bleeker (PBL, NL)

This task allows for the continuation of Task 2.5.1, extending it beyond GEF actions to engage with other sources of information, including from other regional programmes, bilateral initiatives and INMS regional demonstrations. The database and report will be updated accordingly.

Task 2.5.3: Preparation of compendium of knowledge on N actions implemented by GEF and others

Task Output 2.5.3: Synthesis supported by database on N actions as contributions to global assessment (A2.2)

Task Co-Leads: Walker (WRI, US) and Bleeker (PBL, NL)

Once the main information gathering phase is completed, it is anticipated that the completed database will be maintained as a living approach through the INMS website. This will allow partners to add further information themselves if this is considered desirable, with the Activity Leaders responsible as moderators and for quality control of the information gathered. The information collected in the database will then provide the resource to prepare a synthesis compendium on measures adopted by GEF and others. The synthesis will seek to cluster different examples, e.g. according to source sector or according to receptor ecosystem using site-based approaches. It will also seek to identify key lessons emerging from the review, e.g. observed recipes for success, lessons of problems to be avoided, cases where there is a risk of pollution swapping, examples of synergy giving win-win-win outcomes etc.

The compendium will provide a key resource that will feed into the global assessment process under Activity 2.2, as well as provide important material to share more widely in Component 4.

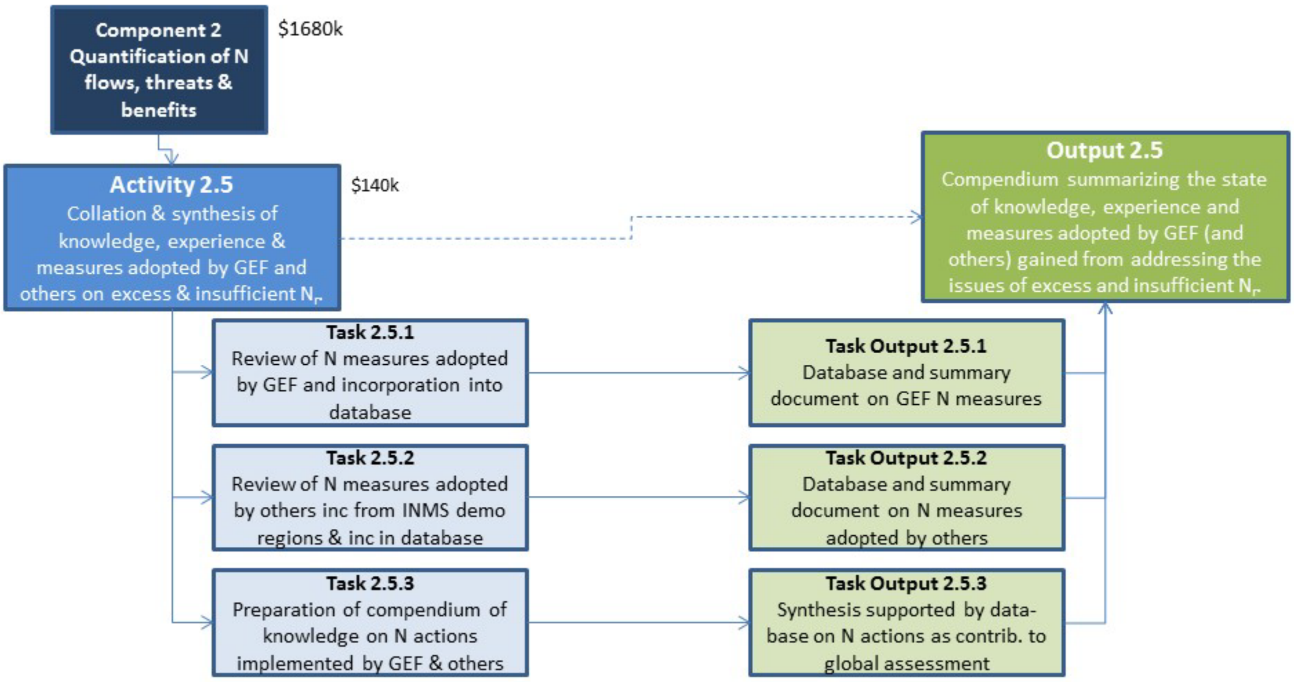


***Figure A16.5:** Summary of Tasks and Task Outputs needed to reach the overall Output in relation to exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis (Activity 2.5; Output 2.5).*

2.5 Budget

2.5.1 GEF Budget

The overall budget for Component 2 is summarized in Table A16.2 below according to the standard UNEP cost codes. This is followed by a detailed breakdown of costs by year for each of the Activities 2.1 to 2.6. An additional activity is identified that allows for technical inputs at the level of Component 2 as a whole to ensure integration.

Code	Heading	**Component 1** A2.1	A2.2	A2.3	A2.4	A2.5	A2.0	**Total C1**
		N flows, threats & benefits	Detailed global assessment	Measures & good practices	Storylines & scenarios	Collation experience of GEF & others	Comp level coord	
1161	Staff & other personnel	60	90	30	20	15	10	225
1561	Travel	30	130	50	25	3		238
2161	Contractual services (inc databases)	36	30	20	0	10		96
2261	Grants to implementing partners	350	200	160	135	110	110	1065
4161	Materials & Supplies	4	50	0	0	2		56
4261	Non-expendable equipment	0	0	0	0	0	0	0
5161	Other Direct Operating costs	0	0	0	0	0	0	0
5581	Evaluation (consultant fees etc)	0	0	0	0	0	0	0
	Total	**480**	**500**	**260**	**180**	**140**	**120**	**1680**

***Table A16.2:** Budget overview for Component 1: Tools and Methods for the Nitrogen Cycle (totals by Activity). Values in $100K.*

Cost Code	Cost Heading	Activity 2.1 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	N flow, threat-benefit technical support	15	15	15	15	60
1561	Travel	Travel for N flow threats and benefits	10	10	10		30
2161	Contractual services (inc databases)	Technical database development (TO 2.1.1)	22	10	2	2	36
2261	Grants to implementing partners	Database population inputs & outcomes (TO 2.1.1)	20	20			40
		International support to regions (TO 2.1.2)	30	30	25	25	110
		Combined analysis of flows/impacts (TO 2.1.3)	10	50	50	20	130
		Quantify present & future benefits/threats (TO 2.1.4)		30	30	10	70
4161	Materials & Supplies	Materials and consumables	2	2			4
4261	Non-expendable equipment	na					
5161	Other Direct Operating costs	na					
5581	Evaluation (consultant fees etc)	na					
	Total		**109**	**167**	**132**	**72**	**480**

Table A16.3: *Budget for Activity 2.1 Quantifying N flows, threats and benefits at global and regional scales (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 2.2 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Techn. Support to global assessment	20	25	30	15	90
1561	Travel	Travel for consolidated global assessment	30	35	35	30	130
2161	Contractual services	Open Access Charges for publication (TO 2.2.5)				30	30
2261	Grants to implementing partners	Preparation scope & structure (TO 2.2.1)	10	10			20
		Commissioning & Preparation of Overview (TO 2.2.2)		70	70		140
		Peer review & Revision (TO 2.2.3)			20		20
		Preparation of Summaries & Workshop (TO 2.2.4)			20		20
4161	Materials & Supplies	Materials and consumables (publication / launch)			2	48	50
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**60**	**140**	**177**	**123**	**500**

Table A16.4: *Budget for Activity 2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 2.3 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Techn. Support to measures & practices	9	7	7	7	30
1561	Travel	Travel for measures & practices	10	20	10	10	50
2161	Contractual services (inc databases)	Updating of practice database (TO 2.3.5)			10	10	20
2261	Grants to implementing partners	Prep of BG docs on state of art (TO 2.3.1)	30				30
		Workshop linking practices & benefits (TO 2.3.2)		45			45
		Revision of papers & GD preparation (TO 2.3.3)			45		45
		Peer & Stakeholder Review of GD (TO 2.3.4).			20		20
		Publishing of GD (TO 2.3.5)				20	20
4161	Materials & Supplies	Materials and consumables					0
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**49**	**72**	**92**	**47**	**260**

Table A16.5: *Budget for Activity 2.3 Integrating methods, measures & good practices to address issues of excess & insufficient reactive nitrogen (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 2.4 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Techn. Support to storylines & scenarios	5	5	5	5	20
1561	Travel	Travel for storylines & scenarios	10	5	5	5	25
2161	Contractual services (inc databases)	na					0
2261	Grants to implementing partners	Review of existing N policies (TO 2.4.1)	45				45
		Review existing storylines & scenarios (TO 2.4.2)	20	5			25
		Workshop on storylines & scenarios (TO 2.4.3)		35			35
		Synthesis future programs & policy options (TO 2.4.4)			25	5	30
4161	Materials & Supplies	Materials and consumables					
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**80**	**50**	**35**	**15**	**180**

Table A16.6: *Budget for Activity 2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 2.5 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Techn. Support collation & synthesis	5	3	3	4	15
1561	Travel	Travel for collation & synthesis	3				3
2161	Contractual services (inc databases)	Data base support (measures experiences)	2	4	2	2	10
2261	Grants to implementing partners	Review of GEF N measures inc database (TO 2.5.1)	40				40
		Review of N measures of others (TO 2.5.2)	10	30			40
		Preparation of compendium inc database (TO 2.5.3)		20	5	5	30
							0
4161	Materials & Supplies	Materials and consumables	1	1			2
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**61**	**58**	**10**	**11**	**140**

Table A16.7: *Budget for Activity 2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient reactive nitrogen (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Activity 2.0 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Support for Component 2 science direction	3	2	2	3	10
1561	Travel	Travel at component level					0
2161	Contractual services (inc databases)	na					0
2261	Grants to implementing partners	Component Leadership N flows threats and benefit	28	27	27	28	110
							0
							0
							0
4161	Materials & Supplies	Materials and consumables					0
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**31**	**29**	**29**	**31**	**120**

Table A16.9: *Budget for Activity 2.0 Component Leadership: Quantification of N flows, threats & benefits (costs by year). Values in US $100K.*

Cost Code	Cost Heading	Component 2 by year Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Technical support to the activities	57	57	62	49	225
1561	Travel	Travel at component level	63	70	60	45	238
2161	Contractual services	Technical support to databasing & open access	24	14	14	44	96
2261	Grants to implementing partners	Total of grants to partners	243	372	337	113	1065
4161	Materials & Supplies	Materials and consumables	3	3	2	48	56
4261	Non-expendable equipment	na					
5161	Other Direct Operating costs	na					
5581	Evaluation (consultant fees etc)	na					
	Total		**390**	**516**	**475**	**299**	**1680**

Table A16.10: *Budget overview for Component 2: Quantification of N flows, threats & benefits (costs by year). Values in US $100K.*

2.5.2 Co-financing (values in US $)

Partner involvement	Sources of co-financing	Type	Partner name/Name of co-financier	Organisation short name	Country or International	Cash or in-kind co-financing	Total for Component 2
			Partners primarily with global focus in the project				
C1	GEF Agency	Policy support	United Nations Environment Programme	UNEP	Kenya	Cash co-financing	-
						In-kind co-financing	160,000
						Total Co-financing	**160,000**
C2	Non-ministry government body	Science and Policy Support	Natural Environment Research Council	NERC	UK	Cash co-financing	247,657
						In-kind co-financing	1,180,608
						Total Co-financing	1,428,265
C3	Others	Science and Policy Support	University of Edinburgh	UED	UK	Cash co-financing	-
						In-kind co-financing	997,588
						Total Co-financing	997,588
D1	Other Multilateral Agency (ies)	Science	Secretariat to the Convention on Biological Diversity	CBD	Canada	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
D2	Other Multilateral Agency (ies)	Policy support	UNECE Conventions on Transboundary Water and Transboundary Air Pollution	UNECE	Switzerland	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D3	Other Multilateral Agency (ies)	Policy support	Organisation for Economic Co-operation and develpment	OECD	France	Cash co-financing	-
						In-kind co-financing	237,000
						Total Co-financing	237,000
D4	Other Multilateral Agency (ies)	Science and Policy Support	Food and Agriculture Organization of United Nation	FAO - AGA	International	Cash co-financing	-
						In-kind co-financing	1,393,247
						Total Co-financing	1,393,247
D5	Other Multilateral Agency (ies)	Science	World Meteorological Organisation	WMO	Switzerland	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D6	Other Multilateral Agency (ies)	Science and Policy Support	International Institute for Applied Systems Analysis	IIASA	Austria	Cash co-financing	-
						In-kind co-financing	1,080,000
						Total Co-financing	1,080,000
D7	Other Multilateral Agency (ies)	Science and Policy Support	European Commissions, Joint Research Centre	JRC	International	Cash co-financing	-
						In-kind co-financing	245,000
						Total Co-financing	245,000
D8	Other Multilateral Agency (ies)	Science and Practices	The Interna tional Maize and Wheat Improvement Center	CIMMYT	Mexico	Cash co-financing	-
						In-kind co-financing	150,000
						Total Co-financing	150,000
D9	Non-ministry government body	Science and Policy Support	PBL Netherlands Environmental Assessment Agency	PBL	The Netherlands	Cash co-financing	-
						In-kind co-financing	1,150,000
						Total Co-financing	1,150,000
D10	Non-ministry government body	Science	National Institute for Public Health and the Environment The Netherlands	RIVM	The Netherlands	Cash co-financing	-
						In-kind co-financing	400,000
						Total Co-financing	400,000
D11	Non-ministry government body	Science and Policy Support	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	ENEA	Italy	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D12	Non-ministry government body	Science and Practices	National Institute for Agronomic Research	INRA	France	Cash co-financing	-
						In-kind co-financing	145,000
						Total Co-financing	145,000
D13	Ministry government body	Science and Policy Support	United States Environmental Protection Agency	EPA	USA	Cash co-financing	-
						In-kind co-financing	240,000
						Total Co-financing	240,000
D14	Non-ministry government body	Science and Policy Support	Federal Environment Agency	UBA	Germany	Cash co-financing	-
						In-kind co-financing	205,246
						Total Co-financing	205,246
D15	Non-ministry government body	Science and Policy Support	French Agency for Environment and Energy Management	ADEME	France	Cash co-financing	-
						In-kind co-financing	4,200
						Total Co-financing	4,200
D16	Non-ministry government body	Science	Consiglio Nazionale delle Ricerche	CNR	Italy	Cash co-financing	-
						In-kind co-financing	200,000
						Total Co-financing	200,000
D17	Non-ministry government body	Science	Norwegian Meteorological Institute	MET Norway	Norway	Cash co-financing	40,000
						In-kind co-financing	200,000
						Total Co-financing	240,000
D18	Non-ministry government body	Science and Practices	Victorian Department of Economic Development, Jobs, Transport and Resources - Agriculture Division	DEDJTR	Australia	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D19	Others	Science and Policy Support	Alterra Wageningen University and Research Centre	ALTERRA	The Netherlands	Cash co-financing	1,151,783
						In-kind co-financing	303,500
						Total Co-financing	1,455,283
D20	Others	Science and Policy Support	Wageningen University and Research Centre, Livestock Research	WUR LR	The Netherlands	Cash co-financing	110,000
						In-kind co-financing	-
						Total Co-financing	110,000

D21	Others	Science and Policy Support	Energy research Centre of the Netherlands	ECN	The Netherlands	Cash co-financing	-
						In-kind co-financing	328,750
						Total Co-financing	328,750
D22	Others	Science and Policy Support	Vrije Universiteit	VU	The Netherlands	Cash co-financing	-
						In-kind co-financing	125,000
						Total Co-financing	125,000
D23	Others	Science and Practices	Nederlandse organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek	TNO	The Netherlands	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D24	Others	Science and Policy Support	Potsdam Institute for Climate Impact Research	PIK	Germany	Cash co-financing	-
						In-kind co-financing	896,896
						Total Co-financing	896,896
D25	Others	Science	University of Bonn	UBO	Germany	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D26	Others	Science and Practices	Leibniz Institute for Agricultural Engineering	ATB	Germany	Cash co-financing	-
						In-kind co-financing	5,000
						Total Co-financing	5,000
D27	Others	Science and Practices	Aarhus University, Department of Bioscience	AU Bios	Denmark	Cash co-financing	-
						In-kind co-financing	100,000
						Total Co-financing	100,000
D28	Others	Science and Practices	Aarhus University, Department of Agroecology	AU Agro	Demark	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D29	Others	Science and Practices	Aarhus University, Department of Environmental Science	AU, Envs	Denmark	Cash co-financing	-
						In-kind co-financing	463,600
						Total Co-financing	463,600
D30	Others	Science and Practices	Institute of Water Resources Engineering	ASU	Lithuania	Cash co-financing	-
						In-kind co-financing	300
						Total Co-financing	300
D31	Others	Science and Practices	Agrophysical Research Institute	ARI	Russian Federation	Cash co-financing	-
						In-kind co-financing	20,000
						Total Co-financing	20,000
D32	Others	Science Support	Institute of Physicochemical and Biological Problems in Soil Science	IPBPSS	Russian Federation	Cash co-financing	5,000
						In-kind co-financing	15,000
						Total Co-financing	20,000
D33	Others	Science and Practices	Instituto Superior de Agronomia (School of Agronomy) of the University of Lisbon	ISA	Portugal	Cash co-financing	-
						In-kind co-financing	63,000
						Total Co-financing	63,000
D34	Others	Science and Practices	Ataturk Horticultural Central Research Institute	ABKAE	Turkey	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D35	Others	Science and Practices	Fundacao da Faculdade de Ciencias da Universidade de Lisboa, FP	FFCUL	Portugal	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D36	Others	Policy support and Practices	Stockholm Environment Institute at York / York University	SEI York	UK	Cash co-financing	-
						In-kind co-financing	780,100
						Total Co-financing	780,100
D37	Others	Science and Practices	University of East Anglia	UEA	UK	Cash co-financing	-
						In-kind co-financing	98,000
						Total Co-financing	98,000
D38	Others	Science, Practice and Policy Support	North American Nitrogen Center	NANC	USA	Cash co-financing	-
						In-kind co-financing	700,000
						Total Co-financing	700,000
D39	Others	Science and Policy Support	New York University	NYU	USA	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D40	Others	Science and Practices	World Resources Institute	WRI	International	Cash co-financing	-
						In-kind co-financing	122,000
						Total Co-financing	122,000
D41	Others	Science and Practices	University of Missouri	MU	USA	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D42	Others	Science and Practices	AgReseach Limited	AgResearch	New Zeland	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
B1	Private Sector/Business	Policy Interest and Practices	Fertilizers Europe	Fertilizers Europe	Belgium	Cash co-financing	11,000
						In-kind co-financing	-
						Total Co-financing	11,000
B2	Private Sector/Business	Science and Practices	Centre for Plant Nutrition Hanninghof, Yara GmbH & Co.KG, Germany	YARA	International	Cash co-financing	-
						In-kind co-financing	45,000
						Total Co-financing	45,000
B3	Private Sector/Business	Science and Practices	Badische Anilin und Soda Fabrik	BASF	Germany	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-

B4	Private Sector/Business	Science and Practices	SKW Stickstoffwerke Piesteritz GmbH	SKWP	Germany	Cash co-financing	-
						In-kind co-financing	91,000
						Total Co-financing	91,000
B5	Private Sector/Business	Science, Policy and Practices	PigCHAMP Pro Europa S.L.	PCH	Spain	Cash co-financing	-
						In-kind co-financing	60,000
						Total Co-financing	60,000
B6	Private Sector/Business	Policy Interest and Practices	International Fertilizer Industry Association	IFA	France	Cash co-financing	-
						In-kind co-financing	80,000
						Total Co-financing	80,000
B7	Private Sector/Business	Science and Policy Interest	International Plant Nutrition Institute	IPNI	United States	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
B8	Private Sector/Business	Practices Development	European Agricultural Machinery	CEMA	Belgium	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
S1	Civil Society Organisation	Policy and Dissemination	Non-governmental organization New Energy	NGO "New Energy"	Ukraine	Cash co-financing	-
						In-kind co-financing	13,000
						Total Co-financing	13,000
S2	Civil Society Organisation	Policy and Dissemination	World Wide Fund for Nature conservation	WWF	UK	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
S3	Civil Society Organisation	Policy and Dissemination	Planetary Boundary Initiative	PBI	UK	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
			Partners primarily with regional demonstration focus in the project				
			CASE 1: Developing regions with excess reactive nitrogen				
R1	Others	Science and Practices	Institute of Soil Science, Chinese Academy of Sciences	ISSCAS	China	Cash co-financing	50,000
						In-kind co-financing	170,000
						Total Co-financing	220,000
R2	Others	Science and Practices	National Institute for Agro-Environmental Sciences	NIAES	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R3	Others	Science, Practice and Policy Support	China Agricultural University	CAU - Crop	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R4	Others	Science and Practices	China Agricultural University	CAU - Soil	China	Cash co-financing	10,000
						In-kind co-financing	20,000
						Total Co-financing	30,000
R5	Others	Science and Support	Beijing Forestry University	BFU	China	Cash co-financing	-
						In-kind co-financing	140,000
						Total Co-financing	140,000
R6	Others	Science and Practices	Zhejiang University	ZJU	China	Cash co-financing	-
						In-kind co-financing	300,000
						Total Co-financing	300,000
R7	Others	Science and Practices	Chinese Academy of Science, Center for Agricultural Resources Research, Institute of Genetic and Developmental	CARR	China	Cash co-financing	40,000
						In-kind co-financing	200,000
						Total Co-financing	240,000
R8	Others	Science and Practices	Field Science Center for Northern Biosphere, Hokkaido University	FSCNB-HU	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R9	Others	Science and Practices	Research Faculty of Agriculture, Hokkaido University	Ag-HU	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R10	Others	Science and Practices	National Institute for Environmental Studies	NIES	Japan	Cash co-financing	5,000
						In-kind co-financing	5,000
						Total Co-financing	10,000
R11	Others	Science and Practices	Kyoto University	KU	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R12	Multilateral Agency	Policy Support	Partnerships in Environmental Management for the Seas of East Asia	PEMSEA	Philippines	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R13	Others	Science and Practices	Rothamsted Research	RRes	UK	Cash co-financing	140,000
						In-kind co-financing	120,000
						Total Co-financing	260,000
R14	Others	Science and Dissemination	Society for Conservation of Nature	SCON	National	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R15	Others	Science and Practices	BBRI Bangladesh	BRRI	Bangladesh (National)	Cash co-financing	-
						In-kind co-financing	50,000
						Total Co-financing	50,000
R16	Others	Science and Practices	CSIR-National Environmental Engineering Research Institute	NEERI	India	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R17	Multilateral Agency	Policy Support	South Asia Co-operative Environment Programme	SACEP	Sri Lanka	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R18	Others	Science Practices and Policy Support	Earth System Science Centre/National Institute For Space Research	CCST-INPE	Brazil	Cash co-financing	-
						In-kind co-financing	550,000
						Total Co-financing	550,000

			CASE 2: Developing regions with insufficient reactive nitrogen				
R19	Multiulateral Agency	Science and Practices	International Institute of Tropical Agriculture	IITA	International (Africa)	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R20	Multiulateral Agency	Sciense Support	Livestock Systems and Environment International Livestock Research Institute	ILRI	Kenya	Cash co-financing	-
						In-kind co-financing	100,000
						Total Co-financing	100,000
R21	Multiulateral Agency	Practice and Policy Support	Lake Victoria Commission Secretariat	LVBC	Uganda	Cash co-financing	69,000
						In-kind co-financing	50,000
						Total Co-financing	119,000
R22	Others	Science and Practices	Karlsruhe Institute of Technology	IMK-IFU	Germany	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R23	Others	Science and Practices	Ghent University	UGENT	Belgium	Cash co-financing	75,000
						In-kind co-financing	175,000
						Total Co-financing	250,000
R24	Others	Science and Practices	Laboratoire d'Aérologie Observatoire Midi-Pyrénées	LA UMR 5560	France	Cash co-financing	-
						In-kind co-financing	120,000
						Total Co-financing	120,000
			CASE 3: Nitrogen challenges for transition economies				
R25	Others	Science and Practices	Odessa National I. I. Mechnikov University	ONU	Ukraine	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R26	Others	Science and Practices	Institute of agroecology and environmental management of National Academy of Agrarian Sciences	IAEM	Ukraine	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R27	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution "Institute for Engineering and Environmental Problems in Agricultural	IEEP	Russian Federation	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R28	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution "All-Russian Scientific Research Institute for Organic	VNIIOU	Russia	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R29	Others	Science Support	Scientific Research Institute for Atmospheric Air Protection	SRI	Russian Federation	Cash co-financing	-
						In-kind co-financing	150,000
						Total Co-financing	150,000
R30	Multilateral Agency	Policy and Practices Support	Commission on the Protection of the Black Sea Against Pollution	BSC PS	Turkey	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
			CASE 4: Nitrogen challenges for developed regions with excess reactive nitrogen [without GEF resources]				
R31	Others	Science and Practices	University Pierre and Marie Curie	UPMC	France	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R32	Others	Science and Practices	Technical University of Madrid	UPM	Spain	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R33	Others	Science Practices and Policy Support	Centro de Investigaciones Energéticas Medioambientales y Tecnológicas	CIEMAT	Spain	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
						Cash co-financing	$1,954,440
						In-kind co-financing	$14,448,035
						Total	$16,402,475

2.6 Component work-plan and timeline

2.6.1 Timeline

Component 2 operates throughout the duration of the project. Initial building of the work teams, preparatory reviews and cooperation with Component 1 are key aspect for Year 1, providing the basis to develop and apply the agreed approaches in Year 2 and Year 3. Year 4 focuses primarily on completion and consolidation of final messages especially in engagement Components 3 and 4. The activity work-plans show the detailed timing.

2.6.2 Activity Work Plans

M = Meeting, **R**= Report (includes other publications), **W** = Workshop,

Activity 2.1 Quantifying N flows, threats and benefits at global and regional scales	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 2.1.1 Database of shared input, model outcomes & access to measurements		W		R		R										
Task 2.1.2 International support to regional inventories & model application		M				R				R				R		
Task 2.1.3 Combined analysis of present N flows and impacts at global and regional scales						W				R				R		
Task 2.1.4 Quantifying present & future N threats & benefits at global and regional scales		M				M				W				R		
Monitoring and Evaluation					R				R				R			W

Activity 2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 2.2.1 Preparation of scope & structure of consolidated global assessment		W R														
Task 2.2.2 Commissioning of author teams and preparation of the consolidated overview		M				W			W	W						
Task 2.2.3 Peer review of chapters in the global assessment & revision									M							
Task 2.2.4 Preparation of summary docs & review with workshop													W			
Task 2.2.5 Publishing & distribution of consolidated assessment																R W
Monitoring and Evaluation					R				R				R			R

Activity 2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 2.3.1 Preparation of documents on state of the art for N good practices (N form, N effects etc)		W		R												
Task 2.3.2 Workshop to link methods & good practices for N effects (food, water, air, climate etc)						W	R									
Task 2.3.3 Publishing of revised papers and preparation of synthetic guidance document										R						
Task 2.3.4 Peer and Stakeholder review of Synthetic N guidance document												W				
Task 2.3.5 Publishing of synthesis doc & updating of practice database																R
Monitoring and Evaluation					R				R				R			R

Activity 2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 2.4.1 Review of existing N policies for different countries & regions		M		R	M											
Task 2.4.2 Review of existing storylines and scenarios relevant for N		M		R	M											
Task 2.4.3 Workshop on N storylines & scenarios for shared use across the project							W	R								
Task 2.4.4 Synthesis of future programmes and policy options supported by cost benefit analysis									M				R			
Monitoring and Evaluation					R				R				R			R

Activity 2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Task 2.5.1 Review of N measures adopted by GEF and incorporation into database		M		R												
Task 2.5.2 Review of N measures adopted by others inc from INMS demo regions & inc in database					M		R									
Task 2.5.3 Preparation of compendium of knowledge on N actions implemented by GEF and others				R	M				R							
Monitoring and Evaluation					R				R				R			R

2.7 Execution arrangements

The involvement of partners in each component and activity is based on their expressed commitments to the project. Leadership of Components and Activities will be confirmed by the Project Partners Assembly or amended at the start of the project. Figure A16.6 shows the provisional organogram used to prepare the project, subject to this confirmation.

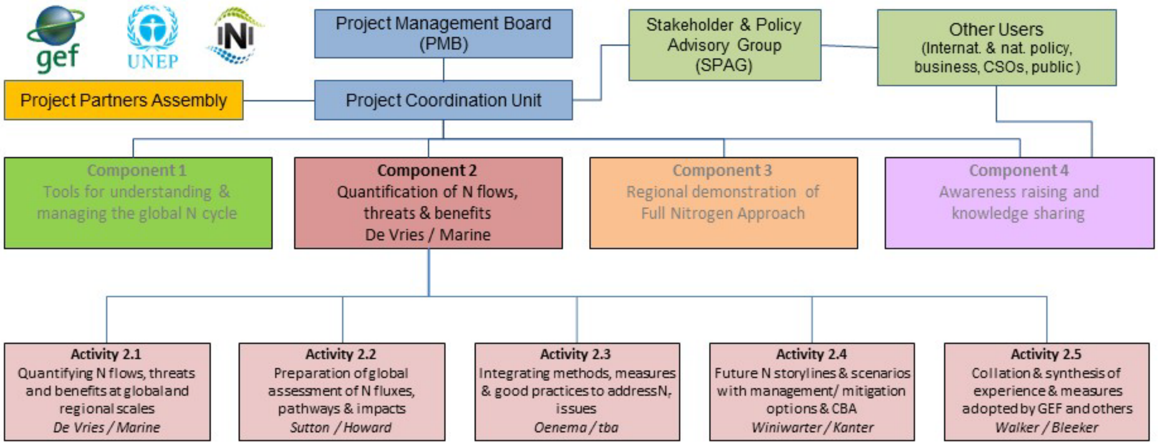


Figure A16.6: *Organogram of Component 2.*

2.8 Component M&E

The day-to-day monitoring of the activities of Component 4 of 'Towards INMS' will be conducted by the Component Leaders and communicated regularly to the PCU (and through the Component Leaders' presence in the PMB). This will enable the PCU to report to UNEP, in addition to the internal needs of progress reporting to the Project Management Board and Project Partners Assembly. The Task and Activity Leaders will also be responsible for providing regular reports on progress to their respective Activity Leaders and the Component Leaders, to enable them to fulfil their reporting requirements. The Terms of Reference for Component, Activity and Task Leaders is set out in Appendix 11.

The overall expectations of Component 2 are presented in the annex to this component with indicators and targets for delivery. These indicators have also been used to establish mid-term and end-of-project targets to enable the relevant external project evaluations to be completed (see Table A16.10).

Table A16.10: *Indicators to support Monitoring and Evaluation of Component 2.*

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Activity 2.1 Quantifying N flows, threats and benefits at global and regional scales				
Task 2.1.1 Database of shared input, model outcomes & access to measurements	Database established & populated, common datasets, results & access to sources		Report from workshop held to establish needs of the INMS database(s) Documentation on INMS data completed (INMS databases and links to other data holdings)	Report from workshop held to establish needs of the INMS database(s) Documentation on INMS data completed (INMS databases and links to other data holdings)
Task 2.1.2 International support to regional inventories & model application	Regional demonstrations supported with inventory expertise and models		Report on first call for supporting activities delivered	Report on all calls for supporting activities delivered
Task 2.1.3 Combined analysis of present N flows and impacts at global and regional scales	Report with data shared on global & regional N flows , threats & benefits available and accepted		Report from workshop on global & regional N flows, threats & benefits delivered.	Report with data shared on global & regional N flows , threats & benefits delivered
Task 2.1.4 Quantifying present & future N threats & benefits at global and regional scales	Report comparing present situation with future scenarios of benefits and threats available and accepted		Reports from meetings held to compare present situation with future scenarios of benefits and threats delivered	Report comparing present situation with future scenarios of benefits and threats delivered
Activity 2.2 Preparation of global assessment of N fluxes, pathways and impacts assimilating lessons from the regional demonstrations				
Task 2.2.1 Preparation of scope & structure of consolidated global assessment	Scope & outline structure of global assessment of N fluxes, pathways & impacts available and agreed		Scope & outline structure of global assessment of N fluxes, pathways & impacts delivered	Scope & outline structure of global assessment of N fluxes, pathways & impacts delivered
Task 2.2.2 Commissioning of author teams and preparation of the consolidated overview	Authors appointed and outline chapter drafts available and agreed		Report from one workshop on appointing authors and scoping outlines for chapter drafts	Report to PPA on appointed authors
Task 2.2.3 Peer review of chapters in the global assessment & revision	Peer review of chapters in the global assessment & revision achieved		[This Task starts in yr 3]	Report to PPA on peer review process for Global Assessment
Task 2.2.4 Preparation of summary docs & review with workshop	Documents reviewed by PPA, SPAG & other stakeholders		[This Task starts in yr 3]	Report from review workshop

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 2.2.5 Publishing & distribution of consolidated assessment	Published report with wide public dissemination		[This Task starts in yr 4]	Report published in hardcopy, launch held.
Activity 2.3 Integrating methods, measures & good practices to address issues of excess & insufficient Nr				
Task 2.3.1 Preparation of documents on state of the art for N good practices (N form, N effects etc)	Background documents produced & available at workshop		Background documents delivered	Background documents delivered
Task 2.3.2 Workshop to link methods & good practices for N effects (food, water, air, climate etc)	Basis for developing guidance linking N forms & issues, high-lighting most promising options available and accepted		Report from workshop on developing guidance linking N forms & issues, high-lighting most promising options delivered	Report from workshop on developing guidance linking N forms & issues, high-lighting most promising options delivered
Task 2.3.3 Publishing of revised papers and preparation of synthetic guidance document	First draft of guidance doc synthesized for wide review available and accepted		Skeleton version of draft guidance document developed from T2.3.2 workshop report	First draft of guidance doc synthesized for wide review delivered
Task 2.3.4 Peer and Stakeholder review of Synthetic N guidance document	Text of consolidated guidance document available and accepted		[This Task starts in Yr3]	Finalized text of consolidated guidance document delivered
Task 2.3.5 Publishing of synthesis doc & updating of practice database	Consolidated methods/practice report available and accepted & database published		[This Task starts in Yr4]	Consolidated methods/practice report delivered & database populated
Activity 2.4 Exploration of future N storylines & scenarios with management/ mitigation options & cost-benefit analysis				
Task 2.4.1 Review of existing N policies for different countries & regions	Database and report on N policies, storylines & scenarios available		Database populated and report on N policies, storylines & scenarios delivered	Database populated and report on N policies, storylines & scenarios delivered
Task 2.4.2 Review of existing storylines and scenarios relevant for N	Background document on N policies & scenarios available and accepted		Background document on N policies & scenarios delivered	Background document on N policies & scenarios delivered
Task 2.4.3 Workshop on N storylines & scenarios for shared use across the project	Strategy for N storylines and scenarios available and accepted		Strategy for N storylines and scenarios delivered	Strategy for N storylines and scenarios delivered

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 2.4.4 Synthesis of future programmes and policy options supported by cost benefit analysis	Report on N policy options & their possible contribution to the Green Economy available and accepted		Agenda for planned document development meeting agreed	Report on N policy options & their possible contribution to the Green Economy delivered
Activity 2.5 Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient Nr				
Task 2.5.1 Review of N measures adopted by GEF and incorporation into database	Database and summary document on GEF N measures available and accepted		Database populated and summary report on GEF N Measures delivered	Database populated and summary report on GEF N Measures delivered
Task 2.5.2 Review of N measures adopted by others inc from INMS demo regions & inc in database	Database and summary document on N measures adopted by others available and accepted		Database populated and summary report on N Measures (outwith GEF) delivered	Database populated and summary report on N Measures (outwith GEF) delivered
Task 2.5.3 Preparation of compendium of knowledge on N actions implemented by GEF and others	Synthesis supported by data-base on N actions as contrib. to global assessment available and accepted		Report from meeting on developing a compendium of N actions and updates to database	Synthesis supported by database on N actions delivered

Annex 1 - Component 2 Results Framework

Outcomes and Outputs	Indicator	Baseline	Target	Sources of Verification	Assumptions
Outcome 3: Regional and Global information on N cycle fluxes and impacts, enabling strategies to be implemented to minimise negative effects of excess or insufficient reactive N, while maximising the quantified co-benefits for other sectors including the Green Economy	Number of new strategies at national, regional or global level to mitigate excess or insufficient N_r using information from INMS [P/SR]	Current policies based on fragmented approach and facing major barriers to change. No coordinated source of information on the global nitrogen cycle for application in policies	Progress towards at least 10 countries using INMS approaches and information to support their national policies 5 countries working on developing integrated nitrogen strategies using INMS resources	• National plans and documentation • Documentation shared through multilateral environmental agreements	National buy-in to INMS process Adequate communication between science assessments and policy development
Output 2.1: Quantification & assessment of the regional threats from excess N and insufficient N	Data and reports to support regional demonstrations [P]	Lack of agreement on approaches. Lack of globally coherent picture across the nitrogen cycle and its multiple impacts.	• Support to regional demos with inventory expertise and models (Yr 2) • Demonstrated comparison of current situation and future scenarios for N threats and benefits • Regional/global approaches incorporated into high profile global assessment (Yr 4)	• High visibility global assessment delivered. • Guidance documentation on N management delivered • Costs benefit analysis delivered • Modelling results reported for present and future conditions • Independent documentation shows take up of results	Data availability in regions and possibility to source necessary data within project timeframe Timely delivery of work from regional demonstrations for inclusion in global assessment
Output 2.2: Detailed overview of regional/local N flux and consolidation into a global assessment of N fluxes and pathways	Completion of regional assessments of N fluxes, including impacts and lessons from demos [P]	Some regional assessments existing, but not available for most regions.	• Agreed scope & outline of global assessment of N fluxes etc. (by end Yr 1) • Commissioned experts delivered high quality chapters passing peer review (Yr 4) • Review of chapters by SPAG, GA and other stakeholders (Yr. 4) • Global assessment report published for wider public dissemination (Yr 4)	• Scoping document shared with partners and external review • Assessment chapters delivered for peer review • Modelling and scenario outcomes and delivered and reported • Body of evidence on success stories and challenges shared • 3 international policy processes using the results	Timely delivery of chapter drafts and reviews
Output 2.3: Consolidation of methods and good practices to address issues of excess and insufficient nitrogen	Specific reports published to support addressing excess and insufficient N [P]	Available guidance documentation only available for fragmented sets of issues, N forms and effects	• Background docs for workshop (Year 2) • Workshop (50 participants) methods for N management and mitigation (Yr 3) • Consolidated methods/practices report & database published (Yr 4)	• Documentation delivered • Users applying documentation as demonstrated by their own documentation	Willingness to share information on methods and include it within the INMS database
Output 2.4: Definition of programmes and policy options for improved Nr management at local/regional/global levels, supported by cost-benefit analysis to underpin options for the Green Economy.	Specific reports published on future N scenarios with mitigation options [P]	Current programmes have little awareness of the links between themselves and other parts of the nitrogen cycle. Fragmentation is a significant contributor to the barriers to change.	• Background docs for workshop (Yr 2) • Workshop (80 participants) on N policies and scenarios completed & reported (Yr 3) • Published report on N policy options & contribution to Green Economy (Yr 4)	• Documentation delivered • Users applying results as demonstrated by their own processes.	Consensus on relevant scenarios achieved Adequate communication between programmes
Output 2.5: Compendium summarizing the state of knowledge, experience and measures adopted by GEF (and others) gained from addressing the issues of excess and insufficient Nr	Published reports [P] Reports on key successes as well of failures and lessons learned distributed to stakeholder network. [P]	STAP report 2011 on eutrophication LRTAP assessment report Examples brought together through the GNC project Little awareness of bi-lateral programmes and successes by wider global community.	• Summary (inc. database) of GEF N management measures (Yr 1) • Summary (inc. database) of non-GEF N management measures (Yr 2) • Contributions to consolidated guidance feeding into Output 2.3	• Documentation delivered • Results incorporated into global assessment report, guidance document and INMS communication documentation	Access to necessary datasets/information to generate compendium possible

Annex 2 - Terms of Reference for Partners and Consultants

Terms of Reference for the roles of Component, Activity and Task Leader along with potential consultants, is included in Appendix 11. The remit of these roles, along with decisions on the institutions and persons taking on these roles for each Component, will be subject to endorsement by the Project Partners Assembly at the Inception meeting of the project.

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 17

Component 3: Regional demonstration of Full Nitrogen Approach

Table of Contents

1 Component Identification

1.1 Component Summary

This component establishes targeted research demonstrations on the nitrogen cycle at a regional scale for each of the main world regions. The approach is to demonstrate how a joined up approach to nitrogen management can catalyse stronger action for a cleaner environment (water, air, greenhouse gas, ecosystems, soils) and improved food and energy production simultaneously. In essence the hypothesis is that a joined up approach across the nitrogen cycle can deliver multiple co-benefits that will strengthen the case for transformational change. The choice of regional scale reflects the need to link between local and global scales, to share regionally specific lessons and to work in partnership with regional intergovernmental and other international processes.

The Component includes the following main Activities:

1. Design common methodology to conduct regional demonstrations of nitrogen flows, priorities, mitigation options, co-benefits, success stories, barriers-to-change and ways of overcoming barriers to change.
2. Conduct the regional demonstrations to refine regional nitrogen assessments and improve understanding of regional N cycle. (This is the main activity – replicated for several different demonstration conditions across the world).
3. Use a workshop to synthesize outcomes from demonstration activities focusing on reducing adverse N impacts & maximizing co-benefits.
4. Build consensus on benchmarking N indicators for different regions and systems, linking between the regions and global scale analysis.
5. Refine the regional approach to demonstrate the benefits of joined up N management, leading to concrete plans of how a perspective from the N cycle can be embedded in the future activities of GPA and other national programs and international conventions.

Five regional demonstrations are included with funding support from GEF according to three cases:

a) Developing regions with excess reactive nitrogen: South Asia, East Asia, Latin America
b) Developing Regions with insufficient reactive nitrogen (East Africa),
c) Transition economies with excess reactive nitrogen (East Europe).

In addition, at least one regional demonstration is planned without specific funding from GEF to cover a fourth condition:

d) Developed regions with excess reactive nitrogen (West Europe). It is expected that additional input from a North American Demonstration may also be developed during the course of Towards INMS.

The scale of both of these additional regional studies will depend on the extent to which resources can be obtained independently from European and North American funding sources.

The outcomes of the Component will feed specifically to support progress in improved nitrogen management for environment, health and food, deliver documentation to support the global consolidated synthesis, and contribute to the goals of regional agreements.

1.2 Links with other Components

This Component delivers the regional demonstration activities (A3.1) and supports the sharing of lessons between each of the regional demonstrations (A3.2-A3.3). It will directly benefit from the tools and methods development of Component 1, especially in the application of developed indicators (A1.1) and threat and flow assessment methodologies (A1.2-A1.3). In return, the regional demonstrations will simultaneously provide concrete examples to test approaches and ideas, such as improving understanding of the barriers to change (A1.6).

A key part of the two way relationship between Component 3 and Components 1 and 2 will be in the ground-truthing and sharing of local and regional knowledge. For example, one of the major uncertainties in global scale modelling of the nitrogen cycle concerns local data and expertise on practices and flows. The developing network between these pools of experts, including the facility to provide international support for regional inventories (Task 2.1.1) provide a vital link to improve information quality and simultaneously contribute to capacity building.

Each of the regional demonstrations will contribute to the preparation of the global assessment of N fluxes, pathways, and impacts (Activity 2.2), with specific chapters highlighting the experiences, messages, lessons learned etc, providing a key opportunity to profile the progress in each region, sharing with a global audience the successes and opportunities identified by the regions. Similarly, it is expected that the regional demonstrations will be critical in informing the development of methods, measures and good practices for improved nitrogen management in Activity 2.3, and of the development of future scenarios and story-lines in Activity 2.4. The mutual engagement between those conducting the collation and synthesis of existing experiences of GEF and others in Activity 2.5 will necessarily benefit from a close cooperation with Component 3.

A close engagement will be maintained between the regional demonstrations and the project coordination office, implemented mainly through Component 4. This will include elements of training and diffusion of knowledge, including nitrogen foot-printing (A4.2), and widening the demonstration of the INMS approach within different international frameworks (A4.3-A4.4).

2 Component Design

2.1 Background and context

The purpose of this component is to demonstrate through regional scale case studies how improved nitrogen management can catalyse a stronger approach for protection of water, air, climate, ecosystems and soils, simultaneously. The essence of the approach is that nitrogen losses affects each of these issues threatening both the environment and human health simultaneously, while nitrogen represents a valuable resource, especially in agriculture. **The hypothesis is that developing a joined up approach will thereby strengthen the case for action, building synergies, minimizing trade-offs, and helping to overcome the barriers to change.** The outcome is that approaches for better nitrogen management should simultaneously contribute, for example, to reducing pollution in the coastal zone and improving the security of food supply. Where such integrated nitrogen approaches can be demonstrated also to meet air quality, soil and biodiversity benefits while reducing greenhouse gas emissions, a much stronger acceptance of measures can be expected.

In establishing this component it is recognized that agriculture is a major source of nitrogen benefits through food and feed production and of threats through pollution. At the same time, agriculture is of special concern because of the substantial barriers-to-change which have been widely recognized when considering each of the nitrogen issues individually. Progress in improvement has been slow in relation to many indicators. For this reason, agricultural nitrogen features centrally in the 'Towards INMS' regional demonstrations. However, it is also clear that all nitrogen sources need to be considered. In addition to both fertilizer nitrogen inputs and biological nitrogen fixation, a substantial amount of reactive nitrogen (c. 40 billion USD as fertilizer value, based on 'Our Nutrient World') is lost to the atmosphere every year. Only a small fraction of this finds its way into productive agricultural use. Similarly, action to manage the nitrogen cycle needs to consider all options available, especially in the context of parallel societal changes. The implications of increasing wealth on food choices and nitrogen pollution, and of waste management, cannot be forgotten.

To address these issues, Component 3 of 'Towards INMS' takes a broad approach, where the main challenges globally are compared between different regional demonstrations. In order to ensure global critical mass, each of the main world regions is represented. In selecting the regional demonstrations, care has been taken to build in all cases on existing activities that form stepping stones to go to the next stage of integration. In many cases these prior partnerships have been developing in existing networks built over several years (e.g. through INI, GPNM, OECD, UNECE, regional seas and water conventions). Towards INMS is the first time that these different groups have all been brought together as such, allowing: i) progress to be made a regional scale, ii) development of a common approach to be applied between the regions, iii) the comparison of lessons between regions, iv) the lessons from the regions to be exchanged with INMS work at the global scale, and vice versa.

The rationale of the Towards INMS regional demonstrations is to focus in each case on a small group of countries who face shared challenges linked by the nitrogen cycle. This allows for lessons to be shared based on the similarity of the systems being addressed regionally. At the same time, however, this approach emphasizes the importance of the regional scale above and beyond the local scale. While local scale activities are included and provide the basis to support key interventions, it is the regional scale that delivers the connection between the local and global scales. In particular the regional scale offers two critical advantages that can help mobilize action for better management of the global nitrogen cycle. Firstly, while many of the barriers-to-change operate regionally (according to the issues faced) there is a close interplay with national/regional governance arrangements meaning that partners in neighbour countries of a regional demonstration have the opportunity to learn lessons from each other. Secondly, this approach provides a direct connection to regional international agreements, such as environmental programmes, regional seas conventions and other bodies. Each of the Towards INMS demonstrations is therefore targeted for development in partnership with at least one regional convention or program. This emphasizes the critical complementary role of international and intergovernmental action regionally and globally.

Five regional demonstrations are included with funding support from GEF according to three conditions: a) Developing regions with excess reactive nitrogen: South Asia, East Asia, Latin America b) Developing Regions with insufficient reactive nitrogen (East Africa), c) Transition economies with excess reactive nitrogen (East Europe). In addition, at least one regional demonstration is planned without specific funding from GEF to cover a fourth condition: d) Developed regions with excess reactive nitrogen (West Europe). In addition, it is expected that additional input from a North American Demonstration may be developed during the course of Towards INMS. The extent of both of these additional regional studies will depend on the extent to which resources can be obtained from European and North American funding sources.

The outcome will be to further develop processes in these regions that both catalyse change towards improved nitrogen management and deliver in each case a specific regional analysis of the challenges faced, prioritization of nitrogen source activities, identification of the most suitable practices and measures in each region, clarification on the barriers to change, engagement with selected local studies that illustrate the approaches being developed and examination of the extent to which a joined up nitrogen approach can help catalyse improved food production and environmental quality simultaneously. Each of the regional demonstration activities will interact with the development of tools (Component 1) and the global scale analysis, including the production of the regional case studies for the global consolidated synthesis in Component 2.

The outcomes of the regional demonstrations include:

a) quantification of the main nitrogen flows differentiated according to source sectors and key loss pathways,
b) better access to and understanding of data availability and limitations,
c) identification and quantification of the major source sectors and uncertainties,
d) highlighting and quantifying the different nitrogen benefits and threats in the region,
e) examination of the biggest nitrogen threats and benefits in this region, (including where feasible cost-benefit analysis), including identification of priorities through engagement with policy and other stakeholders,
f) description in relation to nitrogen performance indicators (in cooperation with the global scale work),
g) review of available options for mitigation and better management of the nitrogen cycle, including identification of co-benefits and trade-offs. Development of a priority list of key options according to regional priorities,
h) profiling of current efforts, success stories, barriers to change and demonstration of how a joined up approach to nitrogen may help overcome them
i) supporting the development of scenarios for future options in cooperation with the global analysis, but informed by the regional evidence.

Key Outputs of Component 3 are:

Output 3.1. Four demonstration cases deliver conclusions refining approaches to regional assessments and improving understanding of regional N cycle:

Case 1: Developing areas with excess N_r. (*South Asia, East Asia, Latin America)*

Case 2: Developing areas with insufficient N_r (*East Africa)*

Case 3: Regions with transition economies (*East Europe)*

Case 4: Developed areas with excess N_r *(West Europe* and potentially North America*)* [*subject to regional co-finance*]

Output 3.2. Assessment and quantification of impacts from piloting activities to reducing negative impacts from poor N_r management, while demonstrating the co-benefits for other issues.

Output 3.3. Refined benchmarking of indicators for different regions and nutrient flow systems.

Output 3.4. Plans for inclusion of agreed approach to N cycle assessments accepted by GPA and others.

2.2 Baseline

With much of the focus of Component 3 being delivered by the individual demonstrations, specific details are referred to in Annexes 17a to 17f which describe the demonstrations themselves. This section therefore focuses on briefly describing the overview and context of the baseline.

2.2.1 Baseline analysis

The global nitrogen cycle is a rapidly emerging research field where the science community has been particularly active at the interfaces of research, policy and practice development. Several areas have already established the beginnings of regional assessment processes or completed such assessments. Examples include the European Nitrogen Assessment,[1] the US assessment of nitrogen and climate interactions,[2, 3] the report of the US EPA Scientific Advisory Board on nitrogen,[4] the Kampala Agenda for action on Nitrogen Management[5] and the analysis of reactive nitrogen in Indian agriculture.[6] Each of these activities have brought understanding of the challenges of managing nitrogen a step forward and built the critical mass of the science and stakeholder community to prepare for the next steps. One of these next steps was the preparation of the Global Overview on Nutrient Management by the GPNM and INI, which included sections on the specific challenges faced by each of the main world regions for improved nitrogen and phosphorus management.[7] The outcome of that process has fed through to develop the critical mass needed that has built up the present set of partnerships for the regional demonstrations.

2.2.2 Gaps

The main gap to date is the development and implementation of a common approach to regional demonstration of improved management of the nitrogen cycle that can be replicated across several regions and therefore feed strongly to support a global approach. The resources of GEF that are focused through 'Towards INMS' are essential to achieve this. In this way the GEF resources act catalytically to draw in substantial national and regional resources allowing progress at the global scale to be achieved. In this way, a modest investment from GEF is able to simulate and direct a much larger global effort.

[1] Sutton M.A., Howard C., Erisman J.W., Billen G., Bleeker A., Grennfelt P., van Grinsven H. and Grizzetti B. (2011) *The European Nitrogen Assessment: Sources, Effects and Policy Perspectives* (Eds.) Cambridge University Press. 612 pp

[2] Suddick E.C., Whitney P., Townsend A.R. & Davidson E.A. (2012) The role of nitrogen in climate change and the impacts of nitrogen–climate interactions in the United States: foreword to thematic issue. Biogeochemistry, DOI 10.1007/ s10533-012-9795-z.

[3] Davidson E.A., David M.B., Galloway J.N., Goodale C.L., Haeuber R., Harrison J.A., Howarth R.W., Jaynes D.B., Lowrance R.R., Nolan B.T., Peel J.L., Pinder R.W., Porter E., Snyder C.S., Townsend A.R. & Ward M.H. (2012) Excess nitrogen in the U.S. environment: trends, risks, and solutions. Issues in Ecology, Report Number 15, Ecological Society of America.

[4] USEPA Science Advisory Board, Integrated Nitrogen Committee (2011) Reactive Nitrogen in the United States: An analysis of Inputs, Flows, Consequences, and Management Options. EPA-SAB-11-013. United States Environment Protection Agency.

[5] Kampala Statement-for-Action on Nitrogen in Africa and Globally (2013) www.initrogen.org

[6] Abrol Y.P., Raghuram N. & Chanakya H.N. (Eds.) (2008) Reactive Nitrogen in Indian Agriculture, Environment and Health. *Current Science* (Nitrogen Special Issue) **94**, 1375-1477.

[7] Sutton M.A., Bleeker A., Howard C.M., Bekunda M., Grizzetti B., de Vries W., van Grinsven H.J.M., Abrol Y.P., Adhya T.K., Billen G.,. Davidson E.A, Datta A., Diaz R., Erisman J.W., Liu X.J., Oenema O., Palm C., Raghuram N., Reis S., Scholz R.W., Sims T., Westhoek H. & Zhang F.S., with contributions from Ayyappan S., Bouwman A.F., Bustamante M., Fowler D., Galloway J.N., Gavito M.E., Garnier J., Greenwood S., Hellums D.T., Holland M., Hoysall C., Jaramillo V.J., Klimont Z., Ometto J.P., Pathak H., Plocq Fichelet V., Powlson D., Ramakrishna K., Roy A., Sanders K., Sharma C., Singh B., Singh U., Yan X.Y. & Zhang Y. (2013) *Our Nutrient World: The challenge to produce more food and energy with less pollution.* Global Overview of Nutrient Management. CEH Edinburgh, on behalf of GPNM and INI. 114 pp.

Further gaps as identified under Annex 15 and Annex 16 for the development of tools and upscaling are equally relevant for each of the demonstration areas.

In a preparatory workshop focusing on nitrogen in agriculture with the fertilizer community, specific attention was given to comparing different nitrogen challenges in different regions. While it is typically emphasized that the challenges faced are very different in each of the regions, one of the surprising messages of that workshop was that there are also substantial common challenges faced by all the regions.[8] The combination of these regional demonstrations will therefore serve to address this gap in more detail, clarifying the real regional differences and garnering a shared gravity to address the common concerns.

2.2.3 Stakeholder analysis

In principle the stakeholder groups are different in each of the regions. However, common elements apply which are specified in Annexes 17a to 17f. In principle the following common stakeholder groups are included:

Researchers: The leading nitrogen researchers are included, especially those engaged at the interface of research, practice and policy development. They are key stakeholders because INMS feeds back to strengthen the case for their other research which may be more fundamental in nature.

Business and Industry Users: Examples in each region include agricultural stakeholders, fertilizer manufacturers and other source sectors as relevant. Further strengthening of engagement through the food chain and with other sectors is expected during the INMS process.

Policy processes and governance users: Each of the regional demonstrations will engage with their governments, especially in facilitating exchange between neighbouring countries. INMS will develop a foundation to support the development of regional 'nitrogen champion' countries that can further the approach. This group includes regional environmental conventions and other programmes, such as the regional seas conventions, UNECE, SACEP, PEMSEA, Lake Victoria Basin Commission, U.S. EPA etc.

Civil Society Groups: The INMS Regional Demonstrations will be used as focus to strengthen engagement with civil society groups. Although several are already involved, such as Worldwide Fund for Nature (WWF) and Plantlife, it is recognized that such groups mainly apply at regional and national level and it is therefore the right scale for the regional demonstrations to develop engagement with these groups.

2.2.4 Criteria for selection of the regional demonstrations

The key purpose of the Towards INMS regional demonstrations is to *demonstrate how a cross-cutting approach that links different parts of the nitrogen cycle, including the benefits and threats, can deliver a stronger gravity for better management of these issues*. We could call it the 'nitrogen snowball' where joining up the snowflakes gives much bigger impact.

It should be remembered that Towards INMS is a 'targeted research project' rather than a classical demonstration project. In this context, the regional activity should therefore be seen as demonstrating the

[8] Brownlie W.J., Howard C.M., Pasda G., Navé B, Zerulla W. and Sutton M.A. (2015) Developing a global perspective on improving agricultural nitrogen use. *Environmental Development*. **15**, 145-151.

research approach and its benefits, showing how it can support international decision making at the regional scale, and how this can in turn support global progress.

The research activities of the Towards INMS team will require close liaison with policy audiences. For example, science can provide information on evidence of the main flows and opportunities for change, but it is a matter of policy to identify priorities. Similarly, while the science community can design scenarios, to be most effective, these will need to be developed considering a two-way interaction with the international policy community.

These key elements can also be related to ideas expressed in the Towards INMS PIF (p 29):
*"For each of the demonstration cases, a **common challenge** is identified in four parts, which then allows the **specific challenges** relevant for each region to be addressed:*
- *To show how improved nitrogen use efficiency can contribute to improving food and energy security while reducing the multiple threats of nitrogen pollution (considering the full chain of nitrogen flow from all main sources and its components).*
- *To quantify the multiple benefits of meeting the "20:20 goal for 2020" identified by Our Nutrient World (to improve NUE by 20% by 2020, saving 20 million tonnes of N globally).*
- *To identify the main options (across Nr releasing sectors) specific to the region to meeting the 20:20 goal, and the main barriers to change.*
- *To engage with a wide range of regional stakeholders in sharing tools, know-how and information about meeting the goals, including highlighting best practices (for sharing within the region and with other regions) and exchanging information on common barriers."*

Based on the PIF and subsequent discussions during 2014 and 2015, the following **criteria for selection** of the Towards INMS regional demonstrations are identified:

1) The demonstration region should cover more than one country. This is necessary to address transboundary pollution issues, allow comparison of success stories and challenges between policy contexts, and address the barriers-to-change which are often international in nature.
2) The demonstration region should be feasible, bearing in mind the needs for cooperation, financing and datasets, while building synergies with other existing and planned activities.
3) Each of the four cases described in the PIF should be addressed:
   Case 1: Challenges and opportunities for developing areas with excess N_r.
   Case 2: Challenges and opportunities for developing areas with insufficient N_r.
   Case 3: Nitrogen challenges and opportunities for regions with transition economies.
   Case 4: Challenges and opportunities for developed areas with excess N_r. (This case can however only be included where national co-financing activities allow it, since the GEF finances are targeted at Cases 1, 2 and 3).

4) The group of case studies should be representative of the key nitrogen challenges faced by different regions across the globe (according to the four cases), and together contribute to the global critical mass to support two-way interaction with the global analysis.
5) The demonstration region should have a convincing science partnership in place, demonstrating readiness and capability to establish the demonstration, including appropriate co-financing.
6) The demonstration region should have a convincing partnership with at least one regional intergovernmental environment programme – ensuring a clear regional policy audience.
7) The demonstration partnership should be able to identify the key outcomes anticipated in terms of capacity building in nitrogen science and management and improved cooperation.

According to the PIF document (p 30) the following regional demonstrations were proposed. These formed the starting point from which the PPG has worked to achieve final agreement between the Partners, the Executing Agency and Implementing Agency. Several rounds of discussion were had, including a preparatory meeting in March 2015 and the Towards INMS First Plenary Meeting in April 2015 in Lisbon.

The initial proposals for INMS regional demonstrations in the PIF were as follows:

Case 1: Regions with excess reactive nitrogen loss. Original proposal: North China Plain - China; South Asia - India / Bangladesh.

Case 2: Regions with insufficient reactive nitrogen. Original proposal: Lake Victoria - Kenya / Uganda; Latin America (offer not yet received at that time).

Case 3: Regions with transition economies. Original proposal: East Baltic – Neva / Narva; Central Asia – Syr Darya; South East Europe, Black Sea – Dniester/Dnieper/Danube

Case 4: Developed countries with excess reactive nitrogen loss. Original proposal: Western Mediterranean – Tajo/Tagus.

These have now been refined and developed further into an agreed set which is described in the following sections. As part of the refinement during the PPG phase we also recognize that the network of partners is associated with significant co-financing to the overall project. Therefore, we amendments have been managed in relation to the need to maintain and build the project partnership and the catalytic role of GEF in drawing in co-financing commitments.

Review of each of the INMS Regional Cases

Considering the criteria listed above, the following comments can be made for each of the four demonstration cases:

Case 1: Regions with excess reactive nitrogen loss

East Asia: A more international approach is has now been developed, focused on the western pacific seaboard, with common problems of marine eutrophication and transboundary nitrogen air pollution, in addition, to national problems of nitrogen with freshwater quality and global contributions to greenhouse gas emissions. The proposed demonstration proposal links China, Japan and the Philippines and it is hoped will in due course include a link with South Korea. Although the Philippines is geographically more separate, it is considered important to share lessons from the GEF Global Nutrient Cycles (GNC) project work on Manila Bay, while the Philippines also hosts the relevant intergovernmental body: PEMSEA (Partnerships in Environmental Management for the Seas of East Asia). The existing science partnership builds on the International Nitrogen Initiative (INI) Regional Centre for East Asia, with strong expertise in agronomy and environmental pollution. This demonstration is described further in Annex 17a.

South Asia: Again a more international approach has now been developed, focused on linking the respective countries allowing information to be fed directly to the support the work of the South Asian Cooperative Environmental Programme (SACEP). Each of the main benefits and threats of nitrogen is considered relevant as a basis to inform the development of a more joined up approach to nitrogen management. The currently proposed region links India, Bangladesh, Sri Lanka and Nepal. Depending on further discussions and co-financing opportunities, it may be possible to incorporate links with Pakistan and Myanmar in future. It will be useful to incorporate lessons from the GEF Global Nutrient Cycles (GNC) project work on Lake Chilika, however, the core focus of the present project is on the regional rather than the local scale. The existing science partnership builds on the INI Regional Centre for South Asia, with strong expertise in agronomy, plant and animal science and environmental pollution, including the coastal zone through links with the LOICZ network. This demonstration is described further in Annex 17b.

Case 2: Regions with insufficient reactive nitrogen

Latin America - La Plata River catchment: The proposal focuses on the La Plata river catchment for Latin American INMS demonstration. In fact, this region contains both areas with too much and too little nitrogen, making it illustrative of the challenges of both Case 1 and Case 2. The La Plata is one of two major international river catchments in Latin America, the other being the Amazon. The La Plata is particularly of interest for INMS since, a) it includes a diversity of nitrogen source sectors, with each of crop agriculture, waste water, biomass burning, livestock rearing being important, b) it links directly to a relevant intergovernmental framework, the La Plata River Commission, c) it overlaps significantly with existing funded work on the nitrogen cycle being coordinated through the Latin American Centre of the INI. By contrast, the River Amazon faces many other challenges, but does not offer this level of resource which is necessary demonstration for the nitrogen cycle. This demonstration is described further in Annex 17c.

East Africa - Lake Victoria catchment: The Lake Victoria catchment links Kenya, Uganda, Tanzania, Burundi and Rwanda, which therefore all have a key interest in its good management. This demonstration builds on several previous GEF funded initiatives, while being unique in its scope to link up nitrogen science and management across the nitrogen cycle. It is presently unclear to what extent waste water, agricultural nitrogen run off, air pollution (e.g. via biomass burning) and erosion problems contribute to the eutrophication problems of Lake Victoria, giving a clear focus to the challenge of the regional demonstration to clarify the respective contributions of these sources. Strong agricultural experience under the lead of the INI Regional Centre for Africa will therefore be complemented by expertise in other disciplines, while the Lake Victoria Basin Commission represents the key intergovernmental framework, as a constituent body of the East African Community. This demonstration is described further in Annex 17d**.**

Case 3: Regions with transition economies

East Europe –Dniester/Prut and lower Danube to Black Sea: Initially it had been proposed to engage also in the *East Baltic* (e.g. Neva/Narva), but it was subsequently agreed to focus efforts of the proposal in *East Europe in relation to the Black Sea*. This change was made in relation to the need to be sensitive to geopolitical realities, as well as to focus resources in a more concentrated fashion. This demonstration region builds directly on the Expert Panel on Nitrogen in EECCA countries (Eastern Europe, Caucasus and Central Asia), established within the Task Force on Reactive Nitrogen (TFRN), under the auspices of the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP). Under this Convention the countries given a clear mandate and priority for TFRN to strengthen engagement with EECCA countries as a basis to support ratification of its protocols. This demonstration offers a clustering between several EECCA countries, with the advantage of significant flexibility depending on the exact boundary to be agreed to the demonstration area. By focusing on the River Dniester/Prut and lower Danube a contiguous area is incorporated that draws together especially engagement between Ukraine, Moldova and Romania, at the same time facilitating a strengthening of engagement between TFRN, the Danube River Basin Commission and the Conmmission for the Protection of the Black Sea. At the same time this approach allows to provide the basis for improved scientific and environmental cooperation with Belarus and Russia, especially through the Expert Panel on Nitrogen in EECCA countries (EPN-EECCA) of the TFRN under the UNECE LRTAP and Transboundary Water Conventions. Development of the partnership is under the lead of the UNECE Task Force on Reactive Nitrogen, in cooperation with the European Centre of the INI.

A key issue in this area has been the substantial reduction in fertilizer use and livestock numbers since 1989, which has led to an improvement in water and air quality. As these transition economies seek to develop it remains an ongoing challenge to ensure that good nitrogen practices are adopted, that can help develop the green nitrogen economy while avoiding to jeopardize these environmental gains. This demonstration is described further in Annex 17e**.**

Note that initially it had been hoped to involve **Central Asia** in this case. However the need for sufficient baseline activities and the need to focus resources resulted in the conclusion that this would not be possible. However, it is still intended to use the international cooperation under Towards INMS to develop the links that would be necessary to establish a nitrogen demonstration in this region under future projects.

Case 4: Developed countries with excess reactive nitrogen loss

European Atlantic Seaboard: This demonstration was originally submitted to the PIF mainly by Spanish partners in cooperation with Portugal, focused on the Tagus, in the hope that this could be a funded activity, which is especially relevant given the economic situation of these countries. However, it has since been made clear that, as part of the EU, this area would not be a priority for GEF funding for regional demonstration, which focuses on developing and transition economies. After the PIF was submitted another proposal has been put forward to build on actions of past and current EU funded projects, which has now been developed further. In particular, an offer has been made to include a demonstration focused on rivers flowing into the Atlantic (from the Pillars of Hercules to the English Channel: including parts of Spain, Portugal, France, England, Belgium). This demonstration would also link closely with the work of the EU NitroPortugal project, which will produce the basis for a first Portuguese Nitrogen Assessment, through a series of workshops, staff exchange, data sharing and training activities. Although the GEF funds would not support a West Europe demonstration directly, the involvement of substantial added value would add to the critical mass of the INMS network. Key issues in this region include nitrogen management in the context of limited water availability and increasing livestock sector (Spain), while linking with air pollution and greenhouse gas goals. The point of engagement with this network is through the European Centre of the International Nitrogen Initiative. This demonstration is described further in Annex 17f. The extent of this demonstration will depend on the availability of independent resources.

Other Offers: Depending on the availability of funds from other, it may also be possible to associate other regional demonstration actions with INMS. For example, we discussions with North American partners indicate an interest to develop an INMS Regional demonstration in *North America* (e.g. US Canada interaction; Gulf of Mexico). It is anticipated that such a demonstration may be developed during the inception phase of Towards INMS. The extent of this demonstration would depend on the availability of independent resources.

Review of the options in relation to selection criteria

The following table examines the demonstrations as originally proposed for review in relation to the selection criteria. This was used to inform discussions during the PPG phase, from which the final set was agreed by the project partners during the Towards INMS Plenary Meeting in Lisbon in 2015.

Criteria	East Asia [a]	South Asia [b]	Latin America (La Plata catchment)[d]	East Africa (Lake Victoria catchment)[c]	East Europe (East Baltic)[e]	E. Europe (Dniester/Prut Lower Danube)[f]	Central Asia (Syr Darya) [g]	W. Europe (Atlantic seaboard)[h]
1. More than one country.	Yes (3-4 countries)	Yes (4, potentially 6 if extra funding)	Yes (5 countries)	Yes (4 countries)	Yes (3-4)	Yes (5 countries)	Yes (4 countries)	Yes (5 countries)
2. Feasibility (cooperation, data, finance, synergies)	Yes	Yes	Yes	Yes	No (due to geopolitical constraints)	Yes	No (not yet sufficient network)	Yes (subject to EU project resources)
3. Covers each of the Cases 1 to 4	Case 1	Case 1	Mix of Case 1 & Case 2	Case 2	Case 3	Case 3	Case 3	Case 4
4. Representative of key world regions & contributes to global critical mass	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. Convincing partnership with readiness for demonstration	Yes	Yes	Yes	Yes	Yes (but not GEF finance)	Yes	Not yet (needs prior capacity building)	Yes
6. Partnership with intergovernmental framework	Yes, PEMSEA	Yes, LVBC	Yes La Plata basin commission	Yes, SACEP	Yes, LRTAP & HELCOM	Yes, LRTAP, Danube Commission & Black Sea Commission	Yes, LRTAP and UNECE Water Convention	Yes, LRTAP, OSPAR, UNECE Water Convention
7. Identification of key outcomes anticipated by the regional demo partnership	Yes, see Annex 17a	Yes, see Annex 17b	Yes, see Annex 17c	Yes, see Annex 17d	Not taken forward to this stage	Yes, see Annex 17e	Not taken forward to this stage	Yes, see Annex 17f

Notes: a, China, Japan, South Korea, with involvement of the Philippines; b, India, Bangladesh, Sri Lanka, Nepal, an potentially (dependent on additional funds) Pakistan and Myanmar; c, Kenya, Uganda, Tanzania, Burundi, Rwanda; d, Brazil, Paraguay, Uruguay, Argentina, Bolivia; e, Russia, Estonia, Latvia, and potentially Finland; f, Ukraine, Moldova, Romania (flexible, as more Danube could be included if additional funds, potential for developing improved cooperation with Russia and Belarus in Dnieper region subject to additional funds); g, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan; h, Spain, Portugal, France, UK, Belgium. Review of options for North America awaits offers to be brought forward for review during inception phase.

Agreement reached during the PPG process

Based on the above table Case 1 can be met by either by East Asia or South Asia or (partly) Latin America. Case 2 can be met by East Africa or (partly) by Latin America. Case 3 can be met by either East Baltic, Dniester/Prut/Lower Danube or Central Asia. However, the East Baltic is not feasible under present circumstances due to geopolitical constraints, while further capacity building would be needed in Central Asia before an INMS demonstration would be feasible.

Considering each of these with the need to generate global critical mass with each of the main regions covered (as requested by GEF), the following four cases were agreed by between the Towards INMS Partners, the Implementing Agency and the Executing Agency:

Case 1: Regions with excess reactive nitrogen loss.

East Asia (China, Japan, South Korea, including Philippines);

South Asia (India, Bangladesh, Sri Lanka, Nepal, potentially including Pakistan and Myanmar if additional resources can be made available from other sources);

Latin America – La Plata catchment (Brazil, Paraguay, Uruguay, Argentina, Bolivia)

Case 2: Regions with insufficient reactive nitrogen.

East Africa - Lake Victoria catchment (Kenya, Uganda, Tanzania, Burundi, Rwanda);
(**Latin America** is also relevant for this case.)

Case 3: Regions with transition economies.

East Europe –Dniester/Prut/Lower Danube. (Ukraine, Moldova, Romania). This area also provides the opportunity to engage with and develop improved scientific and environmental cooperation with Russia and Belarus.

[Central Asia: While there is not yet sufficient foundation to conduct a Central Asia demonstration, it is proposed to develop the links under the outreach of Component 4 in order to prepare the way to allow a demonstration here in a future project.]

Case 4: Developed countries with excess reactive nitrogen loss.

West Europe – Atlantic Coast (Spain, Portugal, France, UK, Belgium). This may be included to the extent that external funding sources are available.

The inclusion of other areas, e.g. in **North America** must be dependent on other funding opportunities and will be reviewed during the project inception phase.

2.3 Overall objective and outcome

Component 3 forms a key part of Towards INMS contributing to its **Overall Project Objective:**
To improve the understanding of the global/region N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems.

Outcome 3: GPA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient Nr, ensuring that any negative effects are minimised

2.4 Outputs and activities

Overall Component Co-Leads:
INI (Sutton, INMS PCU) and African Centre of INI (Masso, IITA)

2.4.1 Activity 3.1: Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle

Output 3.1: Four demonstration cases deliver conclusions refining approaches to regional assessments and improving understanding of regional N cycle :

Activity Co-Leads:
INI (Sutton, INMS PCU) and Asian Centre of INI (Raghuram, ING-SCON)

The elements of this activity are summarized visually in Figure A15.1. This describes an approach which will be replicated across the four INMS demonsration cases as described in detail in Annexes 17a to 17f.

It includes the following tasks:

- Examination of N flows by source sector & loss pathway; inc improving access to data, leading to quantification of the main flows, better access to data and improved understanding.
- Identification and quantification of the major N source sectors and the major uncertainties
- Identification and agreement of the main threats and benefits related to nitrogen for the region, in cooperation with stakeholders
- Description of the situation in the region accorsing to the N performance indiccators, in cooperation with the global scale analysis of Components 1 and 2, giving a basis to compare regions.
- Review of available options for better N management and mitigation, including consideration of the N co-benefits and any trade-offs, identifhying win-win opportunities and delivering regional priority lists of options.
- Profile success stories, especially through engagement with local or regional programmes, while conversely identifying the main barriers to change, and demonstrating how a joined-up N approach could provide support to help overcome the barriers.
- Contribution to scenario development in cooperation with global analysis, so that the global N scenarios are informed by evidence from the regional demonstrations.

INMS Partners proposing to contribute to this Activity include: NERC (UK), IITA, SCON, UNEP, UED (UK), FAO-AGA, European Commission, CIMMYT, ALTERRA (Netherlands), ECN (Netherlands), PIK (Germany), ATB (Germany), AU-Bios (Denmark), AU-Agro (Denmark), AU-Envs (Denmark), ASU (Lithuania), ABAKE (Turkey), YARA, BASF, SKWP.

East Asia - ISSCAS (China), NIAES (Japan), CAU-CROP (China), CAU-SOIL (China), BFU (China), ZJU (China), CARR (China), FSCNB-HU (Japan), AG-HU (Japan), NIES (Japan), KU (Japan), PEMSEA (Phillipines), RRES (UK)

South Asia – BRRI (Bangladesh), NEERI (India), SACEP (Sri Lanka)

Latin America – CCST-INPE (Brazil)

East Africa – ILRI (Kenya), LVBC (Uganda), IMK-IFU (Germany), UGENT (Belgium), LA UMR 5560 (France)

East Europe - UNECE, ASU (Lithuania), ARI (Russian Federation) , NGO 'New Energy' (Ukraine), ONU (Ukraine), IAEM (Ukraine), IEEP (Russian Federation), VNIIOU (Russian Federation), SRI (Russian Federation), BSCPS (Turkey)

West Europe – INRA (France), ADEME (France), ISA (Portugal), FFCUL (Portugal), PCH (Spain), UPMC (France), UPM (Spain), CIEMAT (Spain)

North America - US EPA (USA), NANC , incorporating contributions from the USGS, US Department of Agriculture, Colorado State University, University of Virginia, US EPA, and Agriculture and Agri-Food Canada

While each of these tasks is mapped out in the Demonstration Annexes noted earlier, the following sections provide a summary account of the main common tasks.

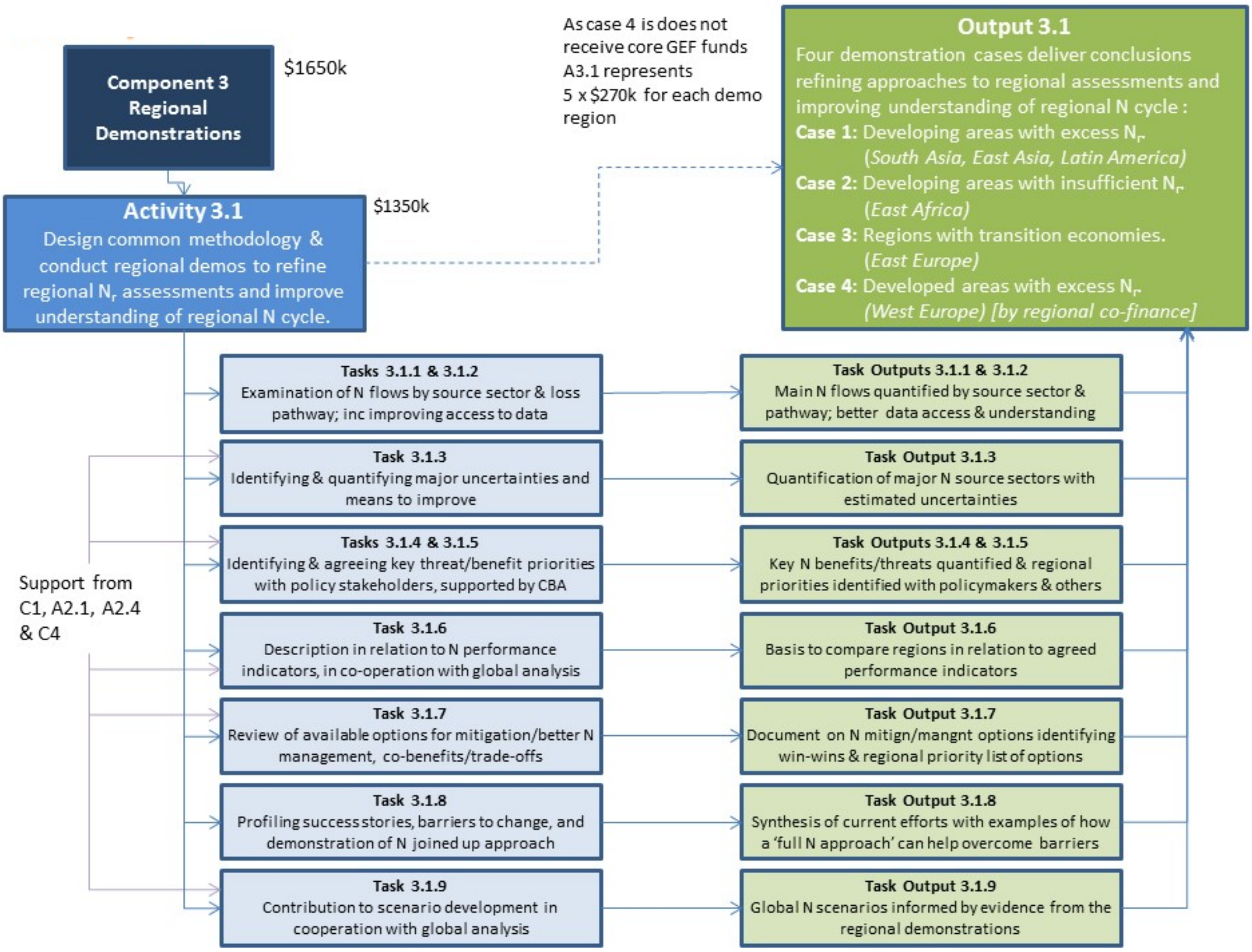


Figure A17.1: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation to designing and conducting the regional demonstrations. (Activity 3.1; Output 3.1). The resource allocation split at Task level is only indicative, and will be tuned according to the needs of each regional demonstration.*

Task 3.1.1 and 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data

Task Output 3.1.1 and 3.1.2: Main N flows quantified by source sector & pathway; better data access & understanding

Task lead: Lead person of each regional demonstration.

The foundation to develop a regional nitrogen strategy must be information on the main nitrogen source activities, flows and loss pathways. In many cases, this is limited by current access to data, where information is not currently processed at a regional level. For example, global analyses are often based on highly simplified aggregations of national datasets, which do not match the actual reality. By contrast, there are many more datasets available than are commonly used for global scale analyses. The regional demonstrations provide an opportunity to develop a more coordinated approach to access such national datasets as a basis for improving the regional evidence. In many cases, this will allow the collection of spatial datasets. While this activity is focused on providing financial support to the regional partners in Component 3, it will also benefit from Task 2.1.2, which will help facilitate international support for such inventory development from relevant experts in the Towards INMS partnership.

Task 3.1.3: Identifying & quantifying major uncertainties and means to improve

Task Output 3.1.3: Quantification of major N source sectors with estimated uncertainties

Task lead: Lead person of each regional demonstration.

The information will be brought together for each region with the task of constructing regional nitrogen budgets, supported by information aggregated at national scales and as far as possible incorporating higher resolution spatial datasets. This will be conducted using a combination of models, datasets and measurements, with support from international partners (Task 2.1.2) with the goal of identifying the major N source sectors, and the main uncertainties in each term. By understanding the available nitrogen resource and its extent of use for targeted purposes (e.g. food, feed and energy production), and by understanding the major N loss terms in the region, this will provide a basis for informed discussion and decision making on a) the main opportunities for better N recycling and reuse, b) the priorities for regional management action to reduce threats and obtain the benefits, c) the priorities for future innovation investments that can harvest the benefits where current technologies are not sufficient.

To give an illustration of the above. Such an assessment for a region may show the percentage of input nitrogen that reaches target products (through nitrogen use efficiency indicators, including at crop, full chain and economy wide scales), identifying the total amount (millions of tonnes) and total fertilizer value (billions of dollars) worth of resource that is wasted. The analysis of the main flows for the region then shows: a) in which form of nitrogen these flows are wasted (e.g. ammonia, nitrous oxide, nitrates, di-nitrogen, other N forms), and therefore where the priorities should lie for pollution reduction based on a resource recovery viewpoint, b) which source sectors and locations are the main places of these losses, which is relevant both to maximize the opportunities for resource recovery and limit adverse environmental effects, c) provide a basis to identify the main environmental threats connected to nitrogen that are relevant for the region.

Task 3.1.4 and 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA

Task Output 3.1.4 and 3.1.5: Key N benefits/threats quantified & regional priorities identified with policymakers & others

Task lead: Lead person of each regional demonstration.

The above information of Tasks 3.1.1 to 3.1.3 provide the basis to start considering the relevant N threat and benefit priorities in the region. Up until this point, most of the work is purely technical in nature, collecting information, working with experts to upscale numbers and developing the synthesis on scientific information on the present status. However, this information then provides the basis for stakeholder engagement on the priority issues. This Task will therefore focus on that stakeholder engagement, sharing information with national and local stakeholders and regional intergovernmental processes to present information on the major flows, sources and impacts and develop consensus on where the priorities for action may lie in the region. By focusing on nitrogen as a resource as much as nitrogen as a pollutant, both sides of the coin will be considered, allowing to strengthen engagement through developing concepts such as resource efficiency and the circular economy.

In this way, it will be emphasized how there are benefits for all players through improved nitrogen management, both for improved profitability in food and energy production, and in business innovation, and for the environment and citizens through reduced water, air and soil pollution. Note that this task does NOT focus on the question of the most suitable policy responses in terms of measures and instruments. Those are for subsequent tasks. The challenge of this task is simply to develop consensus on the main causes of nitrogen pollution in the region and the main opportunities that a joined up approach would bring, identifying the priority focal points for action.

Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis

Task Output 3.1.6: Basis to compare regions in relation to agreed performance indicators

Task lead: Lead person of each regional demonstration.

To support the stakeholder engagement in Tasks 3.1.4 and 3.1.5, the developing work on N sources, flows and impacts will be linked to the parallel work in Component 1 on the development of nitrogen system indicators (Activity 1.1.1). This will allow the information collected in the regional demonstration to be processed in a way that is consistent with developing international standards through Towards INMS, allowing full comparability of results between regions. In addition to specific missions through Task 2.1.2, this work will require cooperation between Component 1 and Component 3, which will take place as part of the Annual Meetings of Towards INMS to promote sharing and effective communication in the project.

Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs

Task Output 3.1.7: Document on N mitigation/management options identifying win-wins & regional priority list of options

Task lead: Lead person of each regional demonstration.

Based on the information on nitrogen flows, sources and major impacts, the dual perspective will be taken of improving business through better nitrogen recovery while reducing environmental pollution. This will then provide the context to go to the next stage of identifying the main options for better nitrogen management and mitigation according to the list of regional priority concerns.

The available options in the region for better nitrogen management will be reviewed, identifying in particular the relevant co-benefits or trade-offs associated with different management technologies and management options. Experience will be taken from existing international guidance on methods to reduce nitrogen pollution (e.g. UNECE on ammonia and nitrogen oxides, UNEP and IPCC on nitrous oxide, regional seas conventions on reducing nitrogen in leaching and run-off), and the INMS Activity 2.3 on developing joined up approaches for better nitrogen management. There will therefore be a close link between this task and Activity 2.3, with the work in Component 3 focusing on the most suitable options for the region, while continuing to emphasize the principle of maximizing co-benefits. The outcome will be a specific document for each region that is developed and tested with regional stakeholders and can also feed into the global analysis.

Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach

Task Output 3.1.8: Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers

Task lead: Lead person of each regional demonstration.

While Towards INMS is a targeted research project rather than a regional implementation of some known measures, it will nevertheless be important to make the connection to actions on the ground. Specifically, such local engagement will seek to work with existing regional or local actions for better nitrogen management, to a) share success stories for where a joined up N approaches is already being practiced and b) to further enhance existing programmes by showing how a joined up N approach can add benefits and help overcome barriers. With available resources for this task, necessarily an efficient path will be needed in the project where selected regional and local case studies may be profiled to show how the Full Nitrogen Approach works out in practice.

At the same time, this profiling will also seek to learn lessons about how a full nitrogen approach can help overcome barriers to change. This will be predicated on improving understanding of what are the main barriers for the priority areas of action identified. The output will be synthesis for each region on current efforts with examples of how the full nitrogen approach can help overcome barriers by delivering simultaneous increase in resource use efficiency (direct financial benefit) and reduction in pollution (societal benefit through improved health and environment) addressing multiple environmental threats simultaneously.

Task 3.1.9: Contribution to scenario development in cooperation with global analysis

Task Output 3.1.9: Global N scenarios informed by evidence from the regional demonstrations

Task lead: Lead person of each regional demonstration.

Unless additional resources are made available for selected INMS regional demonstrations, it is unlikely that specific regional scenarios will be able to be established within the project. However, it is relevant that the global analysis of scenarios and storylines in Towards INMS (Activity 2.4) needs to be informed by evidence and lessons simultaneously being learned at the regional level in Component 3. For this purpose, the present task clearly identifies the need of each of the regional demonstrations to feed into the global scenario development process of Towards INMS in Activity 2.4. In practice, this will be accomplished by each of the Regional Demonstration studies reviewing proposals for scenario development prepared under Activity 2.4. Based on the reflection from the proposals made then will then each construct a short narrative document that reviews the applicability of the proposed scenarios to their region and suggests specific issues / challenges/ opportunities that are relevant to their region based on the emerging lessons.

As these processes between Component 2 and Component 3 operate in parallel, it is anticipated that an iterative approach will also be taken, going through several cycles (e.g. every 18 months, or as needed) which will also allow to iterate to develop a smooth cooperation between the regional and global scale processes.

2.4.2 Activity 3.2: Workshop to synthesize outcomes from demonstration activities focusing on reducing adverse N impacts & maximizing co-benefits

Output 3.2: Assessment and quantification of impacts from piloting activities to reducing negative impacts from poor N_r management, while demonstrating the co-benefits for other issues

Activity Co-Leads:
Asian Centre of INI (Raghuram, ING-SCON) and INI (Sutton, INMS PCU)

For efficiency within the project, most meetings between the regional demonstrations will happen in connection with annual meetings of the partnership. However, this activity allows for a specific workshop focused on distilling the results to finalize clear synthetic outcomes from the demonstrations as a whole. It is anticipated that the workshop will take place during year 3 of the project. As summarized in Figure A17.2 it will include the following tasks:

- Preparation of scope, agenda and workshop, with documentation in coop with global framing
- Hosting of workshop bringing together regional demos in cooperation with global partners
- Peer review and publication of the synthesis document

This synthesis of the regional demonstrations will naturally contribute to the overall consolidate assessment of INMS (Activity 2.3), but with the regional synthesis also published in summary form as a self-standing document. The activity will include contributions from each of the regional demonstrations.

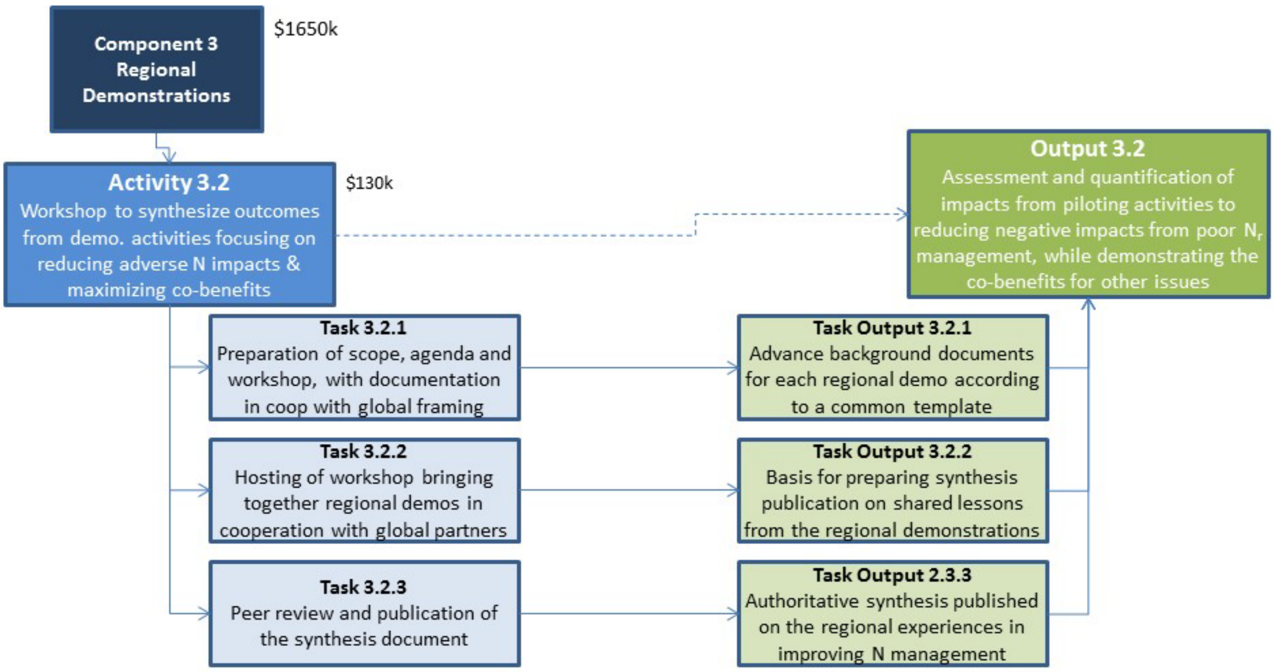


Figure A17.2: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation to the workshop to synthesize outcomes from the regional demonstrations. (Activity 3.2; Output 3.2).*

2.4.3 Activity 3.3: Building consensus on benchmarking N indicators for different regions and systems

Output 3.3: Refined benchmarking of indicators for different regions and nutrient flow systems

Activity Co-Leads: INI European Centre / EU NEP (Oenema, ALTERRA) and INI African Centre (Masso, IITA)

One of the major challenges facing the global and regional linking of the nitrogen cycle the comparison of different performance indicators. In the first stage, work in Component 1 (Activity 1.1) will focus on developing consensus on the form of the nitrogen indicators, especially nitrogen use efficiency. The second stage will be to see how these indicators perform in different regions, and especially develop a common view on appropriate benchmark values of such indicators. Distinction may be made here between indicator values that represent *optimal conditions* and might form the basis for possible goals (at least from a technical viewpoint) as compared with values that might be *achievable in different contexts*, such as due to system or regional constraints.

The main tasks of this activity, as summarized in Figure 17.3 are:

- Regional contribution to scoping paper in cooperation with A1.1, leading to the preparation of a scoping paper considering regional perspectives.
- Regional attendance at INMS workshop sessions with focus on indicator benchmarking, leading to the production of a joint report on regional perspectives for benchmarking N indicators.

INMS partners proposing to contribute to this activity include: ALTERRA (The Netherlands), IITA, LVBC (Lake Victoria Basin Commission, Kenya), UoY (UK), FAO, INRA (France), NERC (UK), SCON-ING (India).

The following have expressed their interest to provide advice and review the work: ATB (Germany), IEEP (Russia), VNIIOU (Russia).

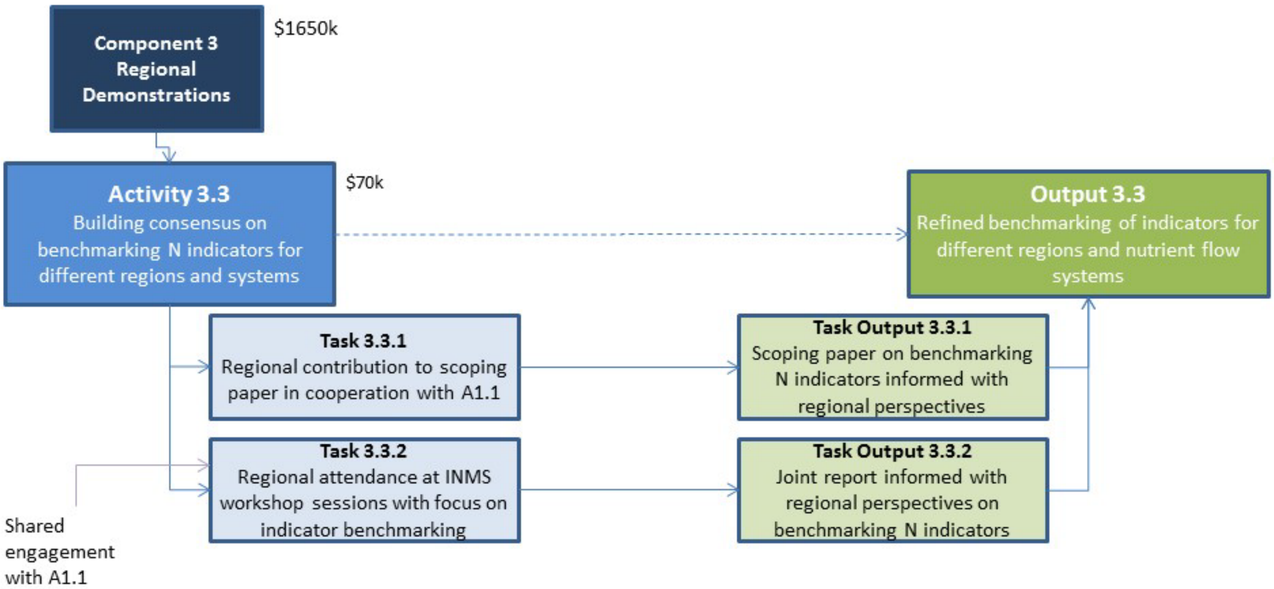


Figure A17.3: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation to building consensus on benchmarking N indicators for different regions (Activity 3.3; Output 3.3).*

2.4.4 Activity 3.4: Refinement of regional approach to demonstrate benefits of joined up nitrogen management

Output 3.4: Plans for inclusion of agreed approach to N cycle assessments accepted by GPA and others

Activity Co-Leads: INI / PCU (Sutton, NERC) and INI / PCU (Howard, NERC)

This task allows for refinement of the design in the regional approach together with demonstration of the benefits of joined up nitrogen management. Building on developments already conducted during the project preparation phase, the first step will be to draft an updated document that explains the rationale of the regional approach for a wider audience. This document will serve to inform first meetings of the PCU with the partners during the inception phase, both together the initial INMS Plenary meetings and through visits to work with the partnerships and their stakeholders, will serve to provide material that helps clarify the approach, address any misunderstandings and strengthen the overall concept. The document will be revised during Year 2 and then be considered a 'living document' allowing further updates and improvement during the life of the 'Towards' INMS project. The document will include aspects that illustrate how the regional approach may be on the one hand a common concept, while on the other hand be tuned to emphasize different regional priorities.

The last stage will then be work under the lead of the PCU to feed the outcomes of the regional approach into the Components and with the wider user community. Specifically, the approach developed will feed into the consolidated global synthesis (A2.2), showing the role of regional information in global nitrogen cycle assessment. At the same time it will provide material feed into Component 4 on wider engagement and dissemination (Activity 4.4), including with partners representing parallel processes, such as GPA, UNEP, OECD, UNECE, CBD, UNFCCC, CCAC, FAO etc.

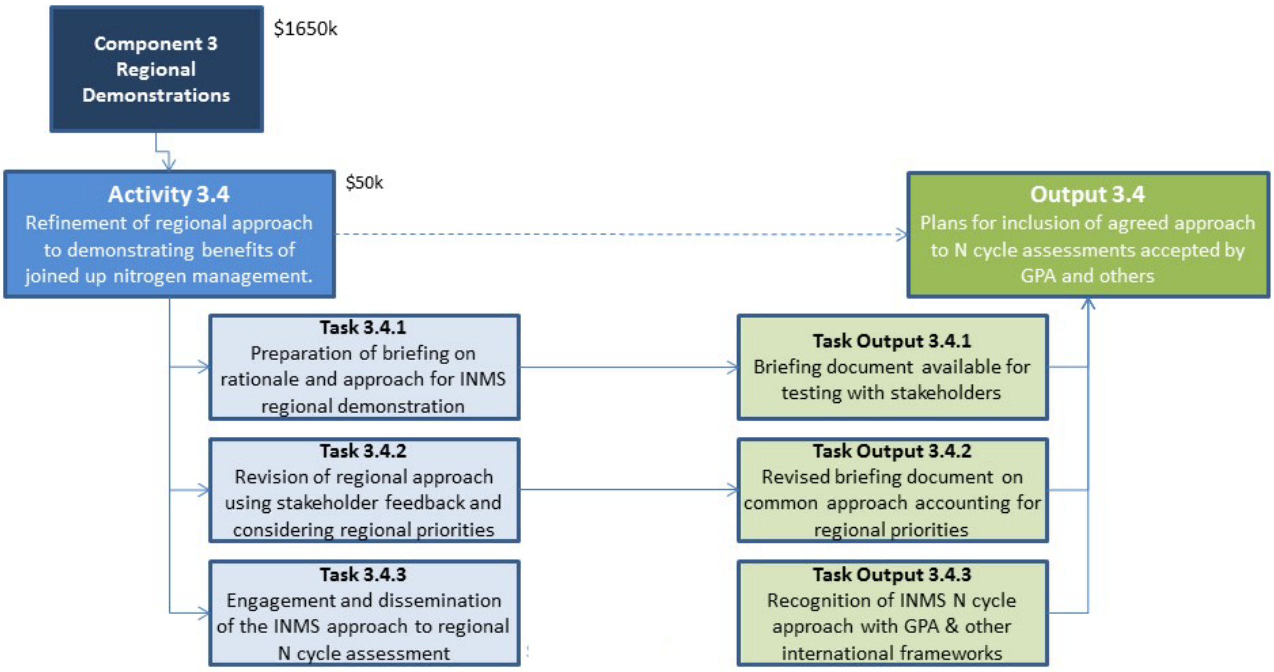


Figure A17.4: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation to refinement and demonstration of benefits of joined up nitrogen approach (Activity 3.4; Output 3.4).*

In addition to each of the Regional Demonstration lead partners, INMS partners proposing specifically to contribute to this activity include: NERC (UK), IITA (Kenya), SCON-ING (India), AU Agro (Denmark, link to TFRN), LVBC (Lake Victoria Basin Commission, Kenya), UNEP (link to GPA and UNFCCC), FAO, CBD, OECD (inc. link to UNFCCC), INRA (France), FFCUL (Portugal) and UoY (UK, link to CCAC).

The following have expressed their interest to provide advice and review the work: ATB (Germany), IEEP (Russia), VNIIOU (Russia).

2.5 Budget

2.5.1 GEF Budget

The overall budget for Component 3 is summarized in Table A17.1 below according the Activities and Tasks. This is followed by a detailed description of the costs according to UNEP Cost Codes in Table A17.2, and then according to the costs by year for each of the Activities 3.1 to 3.4 (Tables A17.3 to A17.6) An additional activity is identified that allows for technical coordination inputs (component leadership, Table A17.7) at the level of Component 3 as a whole, to ensure integration. Finally, Table A17.8 gives the budget overview by year.

Table A17.1: *Budget overview for Component 3: Regional demonstration of Full Nitrogen Approach (unit and total costs by Activity and Task).*

Activity/Task	Unit cost (USD)	Number of units (demos)	Total cost (USD)
Activity 3.1 Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.			
Tasks 3.1.1 & 3.1.2 Examination of N flows by source sector & loss pathway; inc improving access to data	70,000	5	350,000
Task 3.1.3 Identifying & quantifying major uncertainties and means to improve	40,000	5	200,000
Tasks 3.1.4 & 3.1.5 Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	40,000	5	200,000
Task 3.1.6 Description in relation to N performance indicators, in co-operation with global analysis	10,000	5	100,000
Task 3.1.7 Review of available options for mitigation/better N management, co-benefits/trade-offs	30,000	5	150,000
Task 3.1.8 Profiling success stories, barriers to change, and demonstration of N joined up approach	70,000	5	350,000
Task 3.1.9 Contribution to scenario development in cooperation with global analysis	10,000	5	50,000
Activity 3.1 Total			**1,350,000**
Activity 3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits			
Task 3.2.1 Preparation of scope, agenda and workshop, with documentation in coop with global framing	40,000	1	40,000
Task 3.2.2 Hosting of workshop bringing together regional demos in cooperation with global partners	40,000	1	40,000
Task 3.2.3 Peer review and publication of the synthesis document	40,000	1	40,000
Activity 3.2 Total			**130,000**
Activity 3.3 Building consensus on benchmarking N indicators for different regions and systems			
Task 3.3.1 Regional contribution to scoping paper in cooperation with A1.1	30,000	1	30,000
Task 3.3.2 Regional attendance at INMS workshop sessions with focus on indicator benchmarking	40,000	1	40,000
Activity 3.3 Total			**70,000**
Activity 3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.			
Task 3.4.1 Preparation of briefing on rationale and approach for INMS regional demonstration	15,000	1	15,000
Task 3.4.2 Revision of regional approach using stakeholder feedback and considering regional priorities	15,000	1	15,000
Task 3.4.3 Engagement and dissemination of the INMS approach to regional N cycle assessment	20,000	1	20,000
Activity 3.4 Total			**50,000**
Activity 3.0	50,000	1	50,000
Component 3 Total			**1,650,000**

Table A17.2: *Budget overview for Component 3: Regional demonstration of Full Nitrogen Approach (headings according to UNEP cost-codes). Values in '$100K.*

Code	Heading	Component 3 A3.1a Regional demos: S. Asia	A3.1b Regional demos: E. Asia	A3.1c Regional demos: L. America	A3.1d Regional demos: E. Africa	A3.1e Regional demos: E. Europe	A3.2 Workshop & Synthesis	A3.3 Regional bench-marking of indicators	A3.4 Refine regional approach	A3.0 Component level coordn	Totals
1161	Staff & other personnel						80	5	50		135
1561	Travel						50	35			85
2161	Contractual services										0
2261	Grants to implementing partners	270	270	270	270	270		30		50	1430
4161	Materials & Supplies										0
4261	Non-expendable equipment										0
5161	Other Direct Operating costs										0
5581	Evaluation (consultant fees etc)										0
	Total	270	270	270	270	270	130	70	50	50	1650

Table A17.3: *Budget for Activity 3.1: Design methodology & conduct demos on regional N_r assessments (costs by year). Values in '$100K.*

Cost Code	Cost Heading	**Activity 3.1a to 3.1e** Cost Item	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
1161	Staff & other personnel						0
1561	Travel						0
2161	Contractual services						0
2261	Grants to implementing partners	Activity 3.1a: Regional demos: S. Asia	65	65	70	70	270
		Activity 3.1b: Regional demos: E. Asia	65	65	70	70	270
		Activity 3.1c: Regional demos: L. America	65	65	70	70	270
		Activity 3.1d: Regional demos: E. Africa	65	65	70	70	270
		Activity 3.1e: Regional demos: E. Europe	65	65	70	70	270
4161	Materials & Supplies						0
4261	Non-expendable equipment						0
5161	Other Direct Operating costs						0
5581	Evaluation (consultant fees etc)						0
	Total		**325**	**325**	**350**	**350**	**1350**

Table A17.4: *Budget for Activity 3.2: Workshop to synthesize outcomes from demonstration activities (costs by year). Values in*

Cost Code	Cost Heading	**Activity 3.2** Cost Item	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
1161	Staff & other personnel	Support to synthesize outcomes from demo. activities		10	60	10	80
1561	Travel	Travel for workshop to synthesize outcomes from demo. activities			50		50
2161	Contractual services						0
2261	Grants to implementing partners						0
4161	Materials & Supplies						0
4261	Non-expendable equipment						0
5161	Other Direct Operating costs						0
5581	Evaluation (consultant fees etc)						0
	Total		**0**	**10**	**110**	**10**	**130**

'$100K.

Table A17.5: *Budget for Activity 3.3: Building consensus on benchmarking N indicators for different regions (costs by year). Values in*

Cost Code	Cost Heading	**Activity 3.3** Cost Item	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
1161	Staff & other personnel	Support to building consensus on benchmarking		2	3		5
1561	Travel	Workshop sessions on indicator benchmarking		15	20		35
2161	Contractual services	na					
2261	Grants to implementing partners	Regional contribution to scoping paper TO3.3.1		15	15		30
4161	Materials & Supplies						0
4261	Non-expendable equipment						0
5161	Other Direct Operating costs						0
5581	Evaluation (consultant fees etc)						0
	Total		**0**	**32**	**38**	**0**	**70**

'$100K.

Table A17.6: *Budget for Activity 3.4: Refinement of regional approach to demonstrating benefits of joined up nitrogen management (costs by year). Values in '$100K.*

Cost Code	Cost Heading	Activity 3.4 / Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Refinement of approach to demonstrate benefits of joined up N management				50	50
1561	Travel						0
2161	Contractual services						0
2261	Grants to implementing partners						0
4161	Materials & Supplies						0
4261	Non-expendable equipment						0
5161	Other Direct Operating costs						0
5581	Evaluation (consultant fees etc)						0
	Total		**0**	**0**	**0**	**50**	**50**

Table A17.7: *Budget for Activity 3.0: Component leadership, Regional demonstration of Full N Approach (costs by year). Values in '$100K.*

Cost Code	Cost Heading	Activity 3.0 / Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel						0
1561	Travel						0
2161	Contractual services						0
2261	Grants to implementing partners	Component Leadership Regional Demos. (C3)	10	15	15	10	50
4161	Materials & Supplies						0
4261	Non-expendable equipment						0
5161	Other Direct Operating costs						0
5581	Evaluation (consultant fees etc)						0
	Total		**10**	**15**	**15**	**10**	**50**

Table A17.8: Budget overview for Component 3: Regional demonstration of Full Nitrogen Approach (costs by year). Values in '$100K.

Cost Code	Cost Heading	Component 3 by year / Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Technical support to the activities		12	63	60	135
1561	Travel	Travel at component level		15	70		85
2161	Contractual services	Technical services at component level					0
2261	Grants to implementing partners	Total of grants to partners	335	355	380	360	1430
4161	Materials & Supplies						0
4261	Non-expendable equipment						0
5161	Other Direct Operating costs						0
5581	Evaluation (consultant fees etc)						0
	Total						**1650**

2.5.2 Co-financing

Partner involvement	Sources of co-financing	Type	Partner name/Name of co-financier	Organisation short name	Country or International	Cash or in-kind co-financing	Total for Component 3
			Partners primarily with global focus in the project				
C1	GEF Agency	Policy support	United Nations Environment Programme	UNEP	Kenya	Cash co-financing	-
						In-kind co-financing	18,000
						Total Co-financing	18,000
C2	Non-ministry government body	Science and Policy Support	Natural Environment Research Council	NERC	UK	Cash co-financing	142,732
						In-kind co-financing	220,249
						Total Co-financing	362,980
C3	Others	Science and Policy Support	University of Edinburgh	UED	UK	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D1	Other Multilateral Agency (ies)	Science	Secretariat to the Convention on Biological Diversity	CBD	Canada	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
D2	Other Multilateral Agency (ies)	Policy support	UNECE Conventions on Transboundary Water and Transboundary Air Pollution	UNECE	Switzerland	Cash co-financing	-
						In-kind co-financing	60,000
						Total Co-financing	60,000
D3	Other Multilateral Agency (ies)	Policy support	Organisation for Economic Co-operation and develpment	OECD	France	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D4	Other Multilateral Agency (ies)	Science and Policy Support	Food and Agriculture Organization of United Nation	FAO - AGA	International	Cash co-financing	-
						In-kind co-financing	200,000
						Total Co-financing	200,000
D5	Other Multilateral Agency (ies)	Science	World Meteorological Organisation	WMO	Switzerland	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D6	Other Multilateral Agency (ies)	Science and Policy Support	International Institute for Applied Systems Analysis	IIASA	Austria	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D7	Other Multilateral Agency (ies)	Science and Policy Support	European Commissions, Joint Research Centre	JRC	International	Cash co-financing	-
						In-kind co-financing	10,000
						Total Co-financing	10,000
D8	Other Multilateral Agency (ies)	Science and Practices	The Interna tional Maize and Wheat Improvement Center	CIMMYT	Mexico	Cash co-financing	-
						In-kind co-financing	400,000
						Total Co-financing	400,000
D9	Non-ministry government body	Science and Policy Support	PBL Netherlands Environmental Assessment Agency	PBL	The Netherlands	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D10	Non-ministry government body	Science	National Institute for Public Health and the Environment The Netherlands	RIVM	The Netherlands	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D11	Non-ministry government body	Science and Policy Support	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	ENEA	Italy	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D12	Non-ministry government body	Science and Practices	National Institute for Agronomic Research	INRA	France	Cash co-financing	-
						In-kind co-financing	285,000
						Total Co-financing	285,000
D13	Ministry government body	Science and Policy Support	United States Environmental Protection Agency	EPA	USA	Cash co-financing	-
						In-kind co-financing	285,000
						Total Co-financing	285,000
D14	Non-ministry government body	Science and Policy Support	Federal Environment Agency	UBA	Germany	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D15	Non-ministry government body	Science and Policy Support	French Agency for Environment and Energy Management	ADEME	France	Cash co-financing	10,000
						In-kind co-financing	3,000
						Total Co-financing	13,000
D16	Non-ministry government body	Science	Consiglio Nazionale delle Ricerche	CNR	Italy	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D17	Non-ministry government body	Science	Norwegian Meteorological Institute	MET Norway	Norway	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D18	Non-ministry government body	Science and Practices	Victorian Department of Economic Development, Jobs, Transport and Resources - Agriculture Division	DEDJTR	Australia	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D19	Others	Science and Policy Support	Alterra Wageningen University and Research Centre	ALTERRA	The Netherlands	Cash co-financing	33,275
						In-kind co-financing	27,800
						Total Co-financing	61,075
D20	Others	Science and Policy Support	Wageningen University and Research Centre, Livestock Research	WUR LR	The Netherlands	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-

D21	Others	Science and Policy Support	Energy research Centre of the Netherlands	ECN	The Netherlands	Cash co-financing	-
						In-kind co-financing	34,500
						Total Co-financing	34,500
D22	Others	Science and Policy Support	Vrije Universiteit	VU	The Netherlands	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D23	Others	Science and Practices	Nederlandse organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek	TNO	The Netherlands	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D24	Others	Science and Policy Support	Potsdam Institute for Climate Impact Research	PIK	Germany	Cash co-financing	-
						In-kind co-financing	99,175
						Total Co-financing	99,175
D25	Others	Science	University of Bonn	UBO	Germany	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D26	Others	Science and Practices	Leibniz Institute for Agricultural Engineering	ATB	Germany	Cash co-financing	-
						In-kind co-financing	9,000
						Total Co-financing	9,000
D27	Others	Science and Practices	Aarhus University, Department of Bioscience	AU Bios	Denmark	Cash co-financing	-
						In-kind co-financing	150,000
						Total Co-financing	150,000
D28	Others	Science and Practices	Aarhus University, Department of Agroecology	AU Agro	Demark	Cash co-financing	200,000
						In-kind co-financing	500,000
						Total Co-financing	700,000
D29	Others	Science and Practices	Aarhus University, Department of Environmental Science	AU, Envs	Denmark	Cash co-financing	-
						In-kind co-financing	120,000
						Total Co-financing	120,000
D30	Others	Science and Practices	Institute of Water Resources Engineering	ASU	Lithuania	Cash co-financing	-
						In-kind co-financing	1,100
						Total Co-financing	1,100
D31	Others	Science and Practices	Agrophysical Research Institute	ARI	Russian Federation	Cash co-financing	-
						In-kind co-financing	50,000
						Total Co-financing	50,000
D32	Others	Science Support	Institute of Physicochemical and Biological Problems in Soil Science	IPBPSS	Russian Federation	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D33	Others	Science and Practices	Instituto Superior de Agronomia (School of Agronomy) of the University of Lisbon	ISA	Portugal	Cash co-financing	-
						In-kind co-financing	66,000
						Total Co-financing	66,000
D34	Others	Science and Practices	Ataturk Horticultural Central Research Institute	ABKAE	Turkey	Cash co-financing	65,000
						In-kind co-financing	40,000
						Total Co-financing	105,000
D35	Others	Science and Practices	Fundacao da Faculdade de Ciencias da Universidade de Lisboa, FP	FFCUL	Portugal	Cash co-financing	480,000
						In-kind co-financing	50,000
						Total Co-financing	530,000
D36	Others	Policy support and Practices	Stockholm Environment Institute at York / York University	SEI York	UK	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D37	Others	Science and Practices	University of East Anglia	UEA	UK	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D38	Others	Science, Practice and Policy Support	North American Nitrogen Center	NANC	USA	Cash co-financing	-
						In-kind co-financing	820,000
						Total Co-financing	820,000
D39	Others	Science and Policy Support	New York University	NYU	USA	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D40	Others	Science and Practices	World Resources Institute	WRI	International	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D41	Others	Science and Practices	University of Missouri	MU	USA	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D42	Others	Science and Practices	AgReseach Limited	AgResearch	New Zeland	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
B1	Private Sector/Business	Policy Interest and Practices	Fertilizers Europe	Fertilizers Europe	Belgium	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
B2	Private Sector/Business	Science and Practices	Centre for Plant Nutrition Hanninghof, Yara GmbH & Co.KG, Germany	YARA	International	Cash co-financing	-
						In-kind co-financing	10,000
						Total Co-financing	10,000
B3	Private Sector/Business	Science and Practices	Badische Anilin und Soda Fabrik	BASF	Germany	Cash co-financing	-
						In-kind co-financing	50,000
						Total Co-financing	50,000

B4	Private Sector/Business	Science and Practices	SKW Stickstoffwerke Piesteritz GmbH	SKWP	Germany	Cash co-financing	-
						In-kind co-financing	80,000
						Total Co-financing	80,000
B5	Private Sector/Business	Science, Policy and Practices	PigCHAMP Pro Europa S.L.	PCH	Spain	Cash co-financing	-
						In-kind co-financing	40,000
						Total Co-financing	40,000
B6	Private Sector/Business	Policy Interest and Practices	International Fertilizer Industry Association	IFA	France	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
B7	Private Sector/Business	Science and Policy Interest	International Plant Nutrition Institute	IPNI	United States	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
B8	Private Sector/Business	Practices Development	European Agricultural Machinery	CEMA	Belgium	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
S1	Civil Society Organisation	Policy and Dissemination	Non-governmental organization New Energy	NGO "New Energy"	Ukraine	Cash co-financing	-
						In-kind co-financing	2,000
						Total Co-financing	2,000
S2	Civil Society Organisation	Policy and Dissemination	World Wide Fund for Nature conservation	WWF	UK	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
S3	Civil Society Organisation	Policy and Dissemination	Planetary Boundary Initiative	PBI	UK	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
			Partners primarily with regional demonstration focus in the project				
			CASE 1: Developing regions with excess reactive nitrogen				
R1	Others	Science and Practices	Institute of Soil Science, Chinese Academy of Sciences	ISSCAS	China	Cash co-financing	50,000
						In-kind co-financing	250,000
						Total Co-financing	300,000
R2	Others	Science and Practices	National Institute for Agro-Environmental Sciences	NIAES	Japan	Cash co-financing	30,000
						In-kind co-financing	170,000
						Total Co-financing	200,000
R3	Others	Science, Practice and Policy Support	China Agricultural University	CAU - Crop	China	Cash co-financing	400,000
						In-kind co-financing	100,000
						Total Co-financing	500,000
R4	Others	Science and Practices	China Agricultural University	CAU - Soil	China	Cash co-financing	10,000
						In-kind co-financing	30,000
						Total Co-financing	40,000
R5	Others	Science and Support	Beijing Forestry University	BFU	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R6	Others	Science and Practices	Zhejiang University	ZJU	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R7	Others	Science and Practices	Chinese Academy of Science, Center for Agricultural Resources Research, Institute of Genetic and Developmental	CARR	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R8	Others	Science and Practices	Field Science Center for Northern Biosphere, Hokkaido University	FSCNB-HU	Japan	Cash co-financing	-
						In-kind co-financing	45,000
						Total Co-financing	45,000
R9	Others	Science and Practices	Research Faculty of Agriculture, Hokkaido University	Ag-HU	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R10	Others	Science and Practices	National Institute for Environmental Studies	NIES	Japan	Cash co-financing	5,000
						In-kind co-financing	5,000
						Total Co-financing	10,000
R11	Others	Science and Practices	Kyoto University	KU	Japan	Cash co-financing	3,000
						In-kind co-financing	2,000
						Total Co-financing	5,000
R12	Multilateral Agency	Policy Support	Partnerships in Environmental Management for the Seas of East Asia	PEMSEA	Philippines	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R13	Others	Science and Practices	Rothamsted Research	RRes	UK	Cash co-financing	40,000
						In-kind co-financing	80,000
						Total Co-financing	120,000
R14	Others	Science and Dissemination	Society for Conservation of Nature	SCON	National	Cash co-financing	-
						In-kind co-financing	1,150,000
						Total Co-financing	1,150,000
R15	Others	Science and Practices	BBRI Bangladesh	BRRI	Bangladesh (National)	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R16	Others	Science and Practices	CSIR-National Environmental Engineering Research Institute	NEERI	India	Cash co-financing	-
						In-kind co-financing	60,000
						Total Co-financing	60,000
R17	Multilateral Agency	Policy Support	South Asia Co-operative Environment Programme	SACEP	Sri Lanka	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R18	Others	Science Practices and Policy Support	Earth System Science Centre/National Institute For Space Research	CCST-INPE	Brazil	Cash co-financing	-
						In-kind co-financing	500,000
						Total Co-financing	500,000

			CASE 2: Developing regions with insufficient reactive nitrogen				
R19	Multiulateral Agency	Science and Practices	International Institute of Tropical Agriculture	IITA	International (Africa)	Cash co-financing	-
						In-kind co-financing	900,000
						Total Co-financing	900,000
R20	Multiulateral Agency	Sciense Support	Livestock Systems and Environment International Livestock Research Institute	ILRI	Kenya	Cash co-financing	-
						In-kind co-financing	100,000
						Total Co-financing	100,000
R21	Multiulateral Agency	Practice and Policy Support	Lake Victoria Commission Secretariat	LVBC	Uganda	Cash co-financing	30,000
						In-kind co-financing	50,000
						Total Co-financing	80,000
R22	Others	Science and Practices	Karlsruhe Institute of Technology	IMK-IFU	Germany	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R23	Others	Science and Practices	Ghent University	UGENT	Belgium	Cash co-financing	300,000
						In-kind co-financing	-
						Total Co-financing	300,000
R24	Others	Science and Practices	Laboratoire d'Aérologie Observatoire Midi-Pyrénées	LA UMR 5560	France	Cash co-financing	58,000
						In-kind co-financing	323,000
						Total Co-financing	381,000
			CASE 3: Nitrogen challenges for transition economies				
R25	Others	Science and Practices	Odessa National I. I. Mechnikov University	ONU	Ukraine	Cash co-financing	-
						In-kind co-financing	70,000
						Total Co-financing	70,000
R26	Others	Science and Practices	Institute of agroecology and environmental management of National Academy of Agrarian Sciences	IAEM	Ukraine	Cash co-financing	-
						In-kind co-financing	270,000
						Total Co-financing	270,000
R27	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution "Institute for Engineering and Environmental Problems in Agricultural	IEEP	Russian Federation	Cash co-financing	-
						In-kind co-financing	115,000
						Total Co-financing	115,000
R28	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution "All-Russian Scientific Research Institute for Organic	VNIIOU	Russia	Cash co-financing	-
						In-kind co-financing	150,000
						Total Co-financing	150,000
R29	Others	Science Support	Scientific Research Institute for Atmospheric Air Protection	SRI	Russian Federation	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R30	Multilateral Agency	Policy and Practices Support	Commission on the Protection of the Black Sea Against Pollution	BSC PS	Turkey	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
			CASE 4: Nitrogen challenges for developed regions with excess reactive nitrogen [without GEF resources]				
R31	Others	Science and Practices	University Pierre and Marie Curie	UPMC	France	Cash co-financing	-
						In-kind co-financing	200,000
						Total Co-financing	200,000
R32	Others	Science and Practices	Technical University of Madrid	UPM	Spain	Cash co-financing	-
						In-kind co-financing	90,000
						Total Co-financing	90,000
R33	Others	Science Practices and Policy Support	Centro de Investigaciones Energéticas Medioambientales y Tecnológicas	CIEMAT	Spain	Cash co-financing	-
						In-kind co-financing	106,800
						Total Co-financing	106,800
						Cash co-financing	$1,857,007
						In-kind co-financing	$8,397,624
						Total	**$10,254,630**

2.6 Component work plan and timeline

2.6.1 Timeline

Component 3 operates throughout the duration of the project. Initial refinement of the demonstration approach is focused in Year 1, providing the basis to apply the approach in Years 2 and 3. Year 4 focuses primarily on finalizing and applying the outcomes in cooperation with Components 2, 3 and 4. The activity workplans show the detailed timing.

2.6.2 Activity Work Plans

The following nomenclature is used on the diagrams below:

M = Meeting, **R**= Report (includes other publications), **W** = Workshop,

Activity 3.1 Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.	**Year 1**				**Year 2**				**Year 3**				**Year 4**			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Tasks 3.1.1 & 3.1.2 Examination of N flows by source sector & loss pathway; inc improving access to data		**M**				**M**			**W**							
Task 3.1.3 Identifying & quantifying major uncertainties and means to improve																
Tasks 3.1.4 & 3.1.5 Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA		**M**							**W**							
Task 3.1.6 Description in relation to N performance indicators, in co-operation with global analysis									**W**			**R**				
Task 3.1.7 Review of available options for mitigation/better N management, co-benefits/trade-offs		**M**							**W**			**R**				
Task 3.1.8 Profiling success stories, barriers to change, and demonstration of N joined up approach									**W**			**R**				
Task 3.1.9 Contribution to scenario development in cooperation with global analysis		**M**				**M**						**R**				
Monitoring and Evaluation					**R**				**R**				**R**			**R**

Activity 3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 3.2.1 Preparation of scope, agenda and workshop, with documentation in cooperation with global framing									R							
Task 3.2.2 Hosting of workshop bringing together regional demos in cooperation with global partners										M						
Task 3.2.3 Peer review and publication of the synthesis document													R			
Monitoring and Evaluation													R			R

Activity 3.3 Building consensus on benchmarking N indicators for different regions and systems	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 3.3.1 Regional contribution to scoping paper in cooperation with A1.1							R				R					
Task 3.3.2 Regional attendance at INMS workshop sessions with focus on indicator benchmarking	W				W				W			W				W
Monitoring and Evaluation																

Activity 3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management.	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 3.4.1 Preparation of briefing on rationale and approach for INMS regional demonstration	R															
Task 3.4.2 Revision of regional approach using stakeholder feedback and considering regional priorities				W				W				W				
Task 3.4.3 Engagement and dissemination of the INMS approach to regional N cycle assessment																W
Monitoring and Evaluation					R				R				R			R

2.7 Execution arrangements

The involvement of partners in each component and activity is based on their expressed commitments to the project. Leadership of Components and Activities will be confirmed by the Project Partners Assembly or amended at the start of the project. Figure A17.5 shows the provisional organogram used to prepare the project, subject to this confirmation.

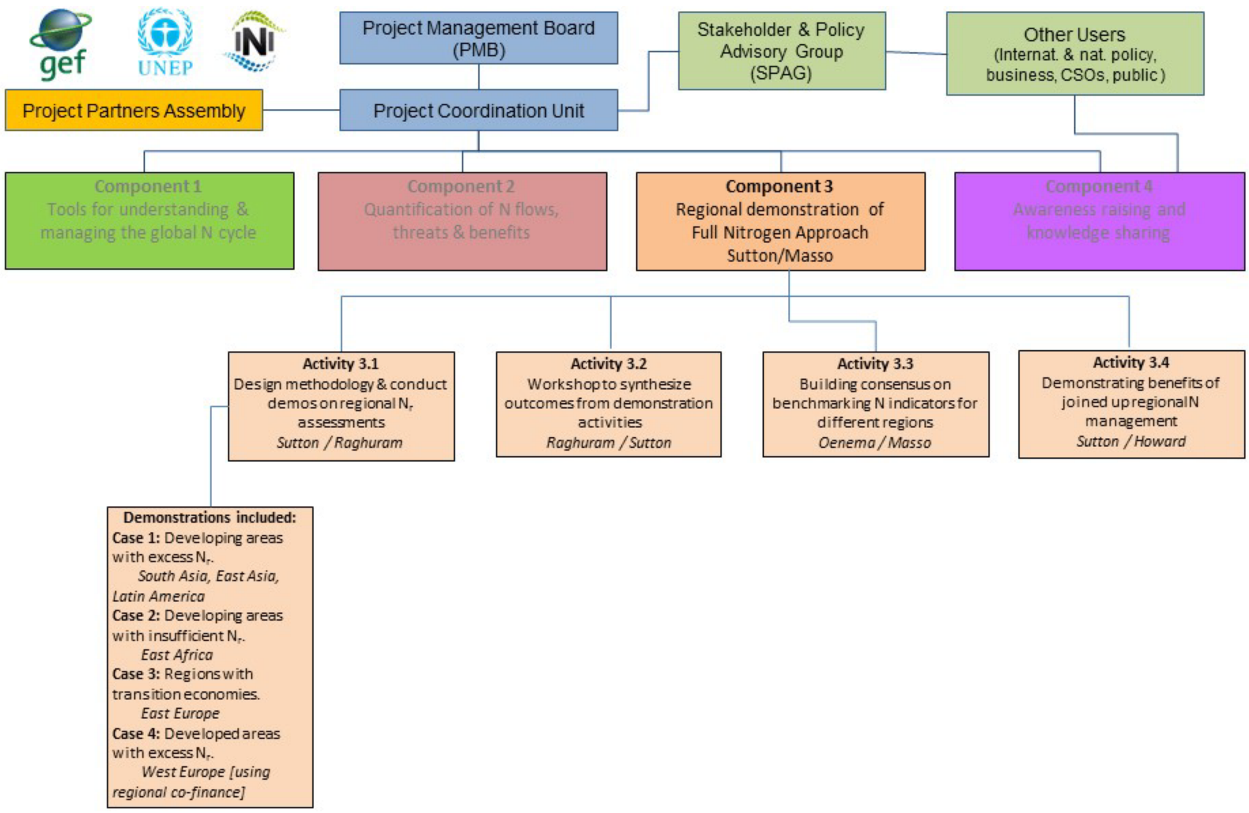


Figure A17.5: *Organogram of Component 3.*

2.8 Component M&E

The day-to-day monitoring of the activities of Component 3 of 'Towards INMS' will be conducted by the Component Leaders and communicated regularly to the PCU (and through the Component Leaders' presence in the PMB). This will enable the PCU to report to UNEP, in addition to the internal needs of progress reporting to the Project Management Board and Project Partners Assembly. In Activity 3.1, the Demonstration Management Group in each region will hold a responsibility to report to the Component 3 Management Group on a regular basis. For Activities 3.2-3.4, the Task and Activity Leaders will also be responsible for providing regular reports on progress to their respective Activity Leaders and the Component Leader, to enable them to fulfil their reporting requirements. The Terms of Reference for Component, Activity and Task Leaders is set out in Appendix 11.

INMS – Component 3

The specific expectations of the regional demonstrations in Component 3 are presented in the Annexes 17a to 17f. Monitoring and evaluation will use indicators as outlined in Table A17.9 which will be used to support mid-term and end-of-project targets to enable the relevant external project evaluations to be completed.

Table A17.9: *Proposed mid-term and end-of-project targets*

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Activity 3.1 Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.				
Tasks 3.1.1 & 3.1.2 Examination of N flows by source sector & loss pathway; inc improving access to data	Main N flows quantified by source sector & pathway; better data access & understanding for 5 regions by end Year 3.		Reports from meetings to quantify main N flows, facilitate better data access and understanding for 5 regions.	Reports from meetings to quantify main N flows, facilitate better data access and understanding for 5 regions.
Task 3.1.3 Identifying & quantifying major uncertainties and means to improve	Quantification of major N source sectors with estimated uncertainties for 5 regions by end Year 3.		Reports to demonstration management board meetings on quantification of major N source sectors with estimated uncertainties for 5 regions.	Reports to demonstration management board meetings on quantification of major N source sectors with estimated uncertainties for 5 regions.
Tasks 3.1.4 & 3.1.5 Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	Key N benefits/threats quantified & regional priorities identified with policymakers & others in 5 regions		Report from initial meeting to identify key N benefits/threats in 5 regions Agenda available for policymaker workshop to quantify key N benefits/threats & regional priorities in 5 regions	Report from policymaker workshop to quantify key N benefits/threats & regional priorities in 5 regions, delivered
Task 3.1.6 Description in relation to N performance indicators, in co-operation with global analysis	Basis to compare regions in relation to agreed performance indicators for 5 regions available and agreed		Agenda available for workshop to develop basis for comparing regions in relation to agreed performance indicators	Report on Basis to compare regions in relation to agreed performance indicators for 5 regions delivered
Task 3.1.7 Review of available options for mitigation/better N management, co-benefits/trade-offs	Document on N mitigation/management options identifying win-wins & regional priority list of options available and agreed for 5 regions		Agenda available for workshop, including draft 'Top 10' priority measures for improved N management, for each regional demo.	Document on N mitigation/management options identifying win-wins & regional priority list of options available and agreed for 5 regions delivered

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 3.1.8 Profiling success stories, barriers to change, and demonstration of N joined up approach	Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers available and agreed		Agenda for workshop to develop synthesis of benefits of a 'full N approach' for 5 regions available	Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers for 5 regions, delivered
Task 3.1.9 Contribution to scenario development in cooperation with global analysis	Global N scenarios informed by evidence from the regional demonstrations		Reports from 2 demonstration management board meetings to review proposals for scenario development, for 5 regions, to ensure fit for purpose.	Report from management board meetings confirming scenarios fit for purpose, for 5 regions, delivered
Activity 3.2 Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits				
Task 3.2.1 Preparation of scope, agenda and workshop, with documentation in coop with global framing	Advance background documents for each regional demo according to a common template available		Common template for background documents, delivered	Advance background documents for each regional demo delivered
Task 3.2.2 Hosting of workshop bringing together regional demos in cooperation with global partners	Basis for preparing synthesis publication on shared lessons from the regional demonstrations		[This Task starts in Yr 3]	Report from workshop on preparing synthesis publication on shared lessons from the regional demonstrations delivered
Task 3.2.3 Peer review and publication of the synthesis document	Authoritative synthesis published on the regional experiences in improving N management		[This Task starts in Yr 3]	Synthesis published on the regional experiences in improving N management
Activity 3.3 Building consensus on benchmarking N indicators for different regions and systems				
Task 3.3.1 Regional contribution to scoping paper in cooperation with A1.1	Scoping paper on benchmarking N indicators informed with regional perspectives available and agreed		First draft of regional contribution to scoping paper in cooperation with A1.1, for 5 regions delivered	Documents on regional perspectives delivered to A1.1.
Task 3.3.2 Regional attendance at INMS workshop sessions with focus on indicator benchmarking	Joint report informed with regional perspectives on benchmarking N indicators	WW	Regional attendance from all 5 regions at INMS workshop sessions with focus on indicator benchmarking	Contributions to joint report on regional perspectives for benchmarking N indicators delivered

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Activity 3.4 Refinement of regional approach to demonstrating benefits of joined up nitrogen management				
Task 3.4.1 Preparation of briefing on rationale and approach for INMS regional demonstration	Briefing document available for testing with stakeholders		Briefing document delivered	Briefing document delivered
Task 3.4.2 Revision of regional approach using stakeholder feedback and considering regional priorities	Revised briefing document on common approach accounting for regional priorities		Reports from 2 workshops to revise common approach	Reports from 3 workshops to revise common approach
Task 3.4.3 Engagement and dissemination of the INMS approach to regional N cycle assessment	Recognition of INMS N cycle approach with GPA & other international frameworks		[This Task starts in Yr 3]	Report on wider engagement activities in showing the role of regional information in nitrogen cycle assessment

Annex 1 - Component 3 Results Framework

Outcomes and Outputs[1]	Indicator	Baseline	Target	Sources of Verification	Assumptions
Outcome 4: GPA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised.	Consolidated global assessment produced, including regional nitrogen assessments [P]	Highly variable focus on nitrogen, separated in regional and national approaches between N form, source and impact,	Five regional nitrogen assessments completed by Year 4 and included in consolidated global assessment (A2.2).	Results published from INMS regional demonstrations	Regional and country buy-in to INMS process
	Synthesis of success stories and strategies to overcome barriers to change published on web portal [P]	Little joined up effort and limited progress	Each regional demonstration identifies success stories and approaches to overcome barriers (by Yr 3)	Published results and working documents.	Inadequate communication between science assessments and policy development
	National and International bodies using INMS results [P/SR]	Need to show how a joined up N approach can help and demonstrate this in international programs and conventions	GPA and regional intergovernmental and international programs making use of INMS outcomes in strategies (by Yr 4)	Working documents and publications of international bodies relevant for INMS regional demos.	Active participation of the populations and policy makers in 5 regions
	Project-level demonstration methodology guidelines adopted and published [P]	Limited information from previous GEF interventions and partial N budget recently developed.	Project level methodology developed and agreed.	Workshop reports	Availability of diversified expertise and technologies in 5 regions
	Requests for and application of demonstration area methodologies, tools and practice by external parties [P]		Uptake of demonstration area methodology in other areas.	Contribution to synthesis documents	Willingness of scientists and policymakers to take on INMS approach
Output 3.1: 3/4 regional/ national/local demonstration activities (that build on existing or planned nitrogen management actions providing catalytic results) deliver conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing: **Case 1:** Challenges and opportunities for developing areas with excess reactive nitrogen. **Case 2:** Challenges and opportunities for developing areas with insufficient reactive nitrogen. **Case 3:** Reactive nitrogen challenges and opportunities for regions with transition economies. **Case 4:** Challenges and opportunities for developed areas with excess reactive nitrogen (using co-financed resources only).	Report on N sources and N flows for each region. [P]	Lack of joined up data on N sources and flows regionally.	Quantified N flows, with uncertainty indication for 4 cases by end Year 3.	Reports, contribution to global synthesis (A2.2).	Insufficient data on N flows available (or able to be gathered), within project timeframe
	Report on consensus on N priority sources, forms and impacts for each region. [P]	Lack of knowledge on how N sources and impacts fit together.	Clearly identified priorities for N sources, forms and impacts for 5 regions by end Year 3	Reports of science-stakeholder workshops, summary reports.	Engagement between scientists and stakeholders at regional and national levels
	Regional condition according to agreed N performance indicators. [P]	Lack of knowledge on how different N indicators relate, especially at regional level.	Statement of regional performance in using internationally agreed N indicators for 5 regions by end Year 3.	Reports and publications, contribution to INMS- wide publications.	Adequate communication between science assessments and policy development
	Information on priority N management and mitigation options. [P]	Diversity of views and lack of consensus on the best methods to obtain N co-benefits.	Draft 'Top 10' priority measures for improved N management for each regional demo (end Yr 3).	Reports provided to A2.3 for incorporation in global comparison.	As above
	Information on successes and opportunities. [P]	Variable progress, with limited attention to linking N co-benefits	Document for each region, showing how N approach can address barriers and share success stories (Yr 4).	Regional Documents for each demonstration.	As above
	Information on regional specificities for global scenarios [P]	Existing global scenarios paying insufficient attention to regional conditions.	Global scenarios informed by evidence from regional demos (Yr 3).	Workshop reports. Report of A2.4 details regional aspects considered.	As above
	Field trials in regional demonstration activities show an improvement of 20% in Nitrogen Use Efficiency [SR]	Variable, dependant on field sites selected.	Field trials in 3 demonstration regions (Yr 4)	Reports from C3 Management Group	Known co-financing at selected demonstrations will allow field trials. Field trials in other demonstration areas will be subject to the availability of additional co-financing.

Outcomes and Outputs	Indicator	Baseline	Target	Sources of Verification	Assumptions
Output 3.2: Assessment and quantification of impacts from piloting activities to reducing negative impacts from poor N_r management, while demonstrating the co-benefits for other issues.	Extent of synthesis between the INMS regional demonstrations [P]	'Our Nutrient World'[9], Ch. 7. Preparatory meeting report.[10]	Workshop with 5+ regional demos and global partners (Yr 3) Workshop outcomes synthesized into consolidated global assessment (A2.2) (Yr 4)	Workshop report Chapter in global assessment Other publications.	Availability of results from demonstration regions
Output 3.3: Refined benchmarking of indicators for different regions and nutrient flow systems.	Agreement on benchmarking N indicators [P]	Progress already started in agreement of N indicators, such as from GPNM, EU-NEP, OECD, TFRN. Need to further refine benchmarking and relationship between efficiency and effect indicators.	Harmonized approach for reporting benchmarking (end Yr 2) Provisional proposals on benchmark values (end Yr 3) Finalization of benchmarking and identification future needs.	Working paper on N indicator benchmarking between regions Meeting and/or mission reports Section on benchmarking incorporated in to global synthesis and practice guidance (A2.2, A2.3).	Consensus on common global approaches for indicators achieved
Output 3.4: Plans for inclusion of agreed approach to N cycle assessments accepted by the GPA	Reports and documents which highlight discussion and inclusion of the N cycle approach being adopted by GPA and other bodies. [P]	N currently treated by policy programmes and conventions separated by form and impact type. Lack of joined up approach	Reports of presentations to GPA and other policy forums, using outcomes of regional demos. Documents of GPA and regional and global policy processes showing impact of N cycle approach including INMS results.	Meeting reports of GPA and other international processes Publications profiling the lessons from INMS regional demos for regional programmes.	Regional and intergovernmental buy-in to the INMS process Adequate communication between science assessments and policy development
Component Management[11] Establish a Component 3 Management Group (C3MG), which will: • Develop a common methodology for regional assessments, including data issues/storage • Monitor progress of the demonstration areas against agreed indicators • Organise the sharing of best practice above the regional level (i.e. between the regional demonstration groups and interactions in global settings). • Support the C3 synthesis activity.	Smooth component management. C3MG support communication across the activity and with Demo Management Groups (DMG's) to share best practice during the project.	N/A	C3MG meet during the inception phase of the project and regularly (on-site or by teleconf. every 3-6 months) during the project to support the DMGs. C3MG co-ordinate a workshop and report to agree a common methodology. Best practice is shared between DMGs, to the wider project and relevant global forums	The C3MG reports to the INMS Project Management Board (PMB). Verification is in the form of the items listed above.	

[9] A project results framework has also been developed for the Component 3 Management strategy, which can be found in Appendix 17.

[10] Sutton M.A. et al. (2013) *Our Nutrient World: The challenge to produce more food and energy with less pollution.* Global Overview of Nutrient Management. CEH Edinburgh, on behalf of GPNM and INI. 114 pp.

[11] Brownlie W.J., Howard C.M., Pasda G., Navé B, Zerulla W. and Sutton M.A. (2015) Developing a global perspective on improving agricultural nitrogen use. *Environmental Development*. **15**, 145-151.

Annex 2 - Terms of Reference for Partners and Consultants

Terms of Reference for the roles of Component, Activity and Task Leader along with potential consultants, is included in Appendix 11. The remit of these roles, along with decisions on the institutions and persons taking on these roles for each Component, will be subject to endorsement by the Project Partners Assembly at the Inception meeting of the project.

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 17a (Activity 3.1a)

EAST ASIA Demonstration

Contents

Abbreviations

APZIFU - Action Plan for the Zero Increase of Fertilizer Use, China

CAA - Clean Air Act, China

CAS - The Chinese Academy of Sciences (CAS)

CBA - cost-benefit analysis

CNW - China Nitrogen Workgroup

DMG - Demonstration Management Group

EEF - Enhanced efficiency fertilizers

HBNF - Haber–Bosch N fixation

HU – Hokkaido University, Japan

INM - integrated soil-crop system management

JpNEG – Japanese Nitrogen Expert Group

JSPS - Japan Society for the Promotion of Science

JST - Japan Science and Technology Agency

MOA - Ministry of Agriculture, China

MoE - Ministry of the Environment, Japan

MOEP - The Ministry of Environmental Protection, China

MOST - The Ministry of Science and Technology, China

NEDO - New Energy and Industrial Technology Development Organization, Japan.

NIAES - National Institute for Agro-environmental Sciences, Japan

NIES - National Institute for Environmental Studies, Japan

NOx - Nitrogen Oxides

Nr - Reactive Nitrogen

NUE - nutrient use efficiency

OECD - The Organization for Economic Cooperation and Development

PEMSEA - The Partnership in Environmental Management for the Seas of East Asia

PM2.5 pollution - particulate matter pollution with a particle size of less than 2.5 microns

PMB - INMS Project Management Board

SAG - Demonstration Stakeholder Advisory Group

1 Introduction to the East Asia Demonstration in 'Towards INMS'

1.1 Background and Context

1.1.1 The regional problem

East Asia, located at the eastern margin of the Eurasian Continent and the western coast of the Pacific Ocean, and is composed of China, Japan, Mongolia, and North and South Korea. Watersheds drain from the landmass into the East China Sea, south of which sit both Taiwan and the Philippines[1]. East Asia contains 22% of the world's population, cultivates 9.2% of the world's arable land and consumes 37% of the world's N fertilizer (FAOSTAT, 2010; Streets and Waldhoff, 2000; Zheng et al., 2002). Furthermore, it has experienced unprecedented increases in food and energy demand in the last three decades.

To support this growth large amounts of N have been added into this region, especially in China, Japan and South Korea. This can be mainly attributed to increasing fertiliser use to increase crop yields. For example, the N fertilizer applied to croplands in China in 1980 was 9.4 Tg N yr^{-1}; by 2010 it was 29.5 Tg N yr^{-1} (Yan et al., 2014). This accounts for nearly a third of global fertiliser use. In some intensive agricultural regions of China, fertilizer N input can be up to 550 kg N ha^{-1} yr^{-1}. In South Korea average fertiliser N input was estimated to be 347 kg ha^{-1} yr^{-1} (for the period 1994 to 1997) (Bashkin et al., 2002). For Japanese croplands, in 2005 a high N surplus of 153 kg N ha^{-1} was reported (Shindo, 2012). Japan depends largely on imported food and animal feed; Japan's calorie-based food self-sufficiency ratio has been steady at 39% in recent years (MAFF, 2014). Although overall N loss due to Japanese consumption must also factor in losses associated with the production of imported food and feed.

Fertilizer N application plays a vital role in ensuring food and energy security, however there is often a low level of fertilizer recovery with associated environmental impacts. With the increase of human population and economic development in this region, reactive N pollution due to fertilizer use and fossil fuel combustion is likely to increase further, along with losses from animal manures and issues relating to the management of sewage. It is therefore likely that East Asia will be an even larger global hotspot for N problems in the future.

1.1.2 Monitoring and evaluation

Existing research related to the N cycle and N management has been fragmented in this region (i.e. separating N forms, sectors and polices). For example, most N assessments and policies and cost–benefit analyses have focused on agroecosystems and the single fate of N losses (Shindo et al., 2003; Sun et al., 2008; Ma et al, 2009; Gu et al., 2012). Therefore, a consolidated research and development initiative which aims to understand the N status in the region and its mechanisms is

[1] Although much further South than the rest of the region described here, the Philippines share the challenges of China, Japan and Korea, including increasing population pressure. This is reflected by the existence of PEMSEA (Partnerships in Environmental Management for the Seas of East Asia, an important stakeholder group within the region. Inclusion of the Philippines will also allow engagement with the GEF-UNEP Global Nutrient Cycles Project work on an 'Ecosystem Health Report Card' in Laguna de Bay. Links with both PEMSEA and the Philippines will be strengthened during project implementation.

required. The establishment of technological capabilities and policies to ensure sustainable N use into the future should also be promoted in the region.

1.1.3 Result of the interventions at both national and regional levels

In China, previous studies have shown large spatial and temporal variation in nitrogen inputs and outputs, and their subsequent impacts on the environment (Ti et al., 2012). Research to improve understanding of the N cycle and soil N biochemistry indicates that nutrient use efficiency (NUE) could be significantly increased through improvements to agricultural practices (Chen et al., 2014). Hence implementation of management policies to improve agriculture practices has the potential to significantly reduce the negative impacts of increasing reactive N nitrogen (Nr) levels, at both national and regional scales. In Japan, whilst water and air pollution by N has been relatively well controlled, improving the NUE of crop and animal production systems represents an opportunity to reduce N losses (Shibata et al. 2014). In Korea, where the N surplus is higher, strategies for integrated N management and the regulation of livestock feeding number have been recommended to be established to improve soil sustainability and environmental health.

1.1.4 Contributions to the INMS understanding/process

China, Japan, South Korea and the Philippines have been facing similar challenges in recent decades, associated with rapidly growing populations and changing diets (i.e. increasing meat consumption). Therefore, the work of the INMS community will benefit this region by providing a platform for exchanging knowledge/information on fundamental nitrogen processes, and policies to reduce nitrogen inputs and abate issues caused by excess nitrogen within the region.

1.1.5 Relevance to national and regional policies

China is now regulating its fertilizer and agrochemical use, aiming at a “zero increase” by 2020. The government is also combating water pollution and air pollution. In China it is well understood that nitrogen is a major contributor to surface water pollution and a cause of the frequent and harmful algal blooms that occur in many of the countries waterbodies. Although, the significant contribution nitrogen makes to air pollution is not so well established, and needs to be better conveyed to stakeholders and the public. In Japan, there is much greater awareness that nitrogen can be both an atmospheric and water pollutant. Japanese environmental policies control emissions of reactive N to the environment (air and water) to prevent direct pollution. However, these policies tend to treat only symptoms of nitrogen pollution, with little focus on addressing the underlying causes.

Developing policies to improve N management and reduce impacts of excess Nr in waters, soils and the atmosphere is not simple. A policy to remedy one issue may inadvertently aggravate another. Thus, a comprehensive and holistic understanding of the regions N status and the mechanisms controlling its N cycle is an initial requirement. Once this has been achieved, national and regional policies to mitigate N issues can be implemented.

1.1.6 Relevance to global / regional agreements and conventions

There are no regional agreements and conventions specifically for Nr in East Asia. However, the East China Sea is an area of common environmental interest in the region. The Partnership in

Environmental Management for the Seas of East Asia (PEMSEA) addresses these environmental interests (along with those associated with the coastline further south) and significant engagement with this group and the demonstration activities will be undertaken. This will ensure there is an adequate connection to ongoing regional policy activities related to the East Asian region and the East China Sea. Not only because the sea is important in this context, but there is also concern of transboundary air pollutants, which may trigger the future development of a future regional agreement or convention.

1.2 Environmental threats, root causes and barrier analysis

1.2.1 Description of the sources, pathways and impact of N (or issues associated with too little – food security etc.)

Excessive use of N fertilizers accompanied with low nitrogen use efficiency increases N_r loss from agricultural systems. Excess levels of N_r in the environment can cause a cascade of detrimental environmental consequences. Emissions of ammonia and oxides of nitrogen lead to air pollution issues, nitrate runoff and leaching can lead to , eutrophication of lakes and coastal waters and both contribute to biodiversity loss at local, national and global scales (Giles, 2005, Liu et al., 2013). High application of N fertilizer to Chinese agricultural systems has already caused significant soil acidification (Guo et al., 2010), and has resulted in decreases in crop growth and the mobilization of heavy metals that can negatively affect soil quality and food safety. Release of the greenhouse gas nitrous oxide from agriculture also contributes to both climate change and destruction of stratospheric ozone.

China is the largest N_r producer from agricultural and industrial activities in the world (Cui et al., 2013). Synthetic fertilizers are the most predominant source of N_r, and play an essential role in food production of China. However, nitrogen use efficiency in China is lower than in Europe. In the intensive agricultural regions, such as the delta region of the Yangtze River and the North China Plain, N fertilizer application rates are between 500-600 kg N ha^{-1} yr^{-1} (Ju et al., 2009). Extremely high N mineral and organic fertilizer inputs are often applied to vegetable crops (up to 1340 and 1782 kg N ha^{-1} yr^{-1} in the Yangtze River Delta and North China Plain, respectively) (Xiong et al., 2006; Zhu et al., 2011).

In Japan, the N surplus in farmland has increased from 553.0 Gg N in 1961, to 838.3 Gg N in 2005. And whilst Japan's population has increased from 95 to 128 million, farmland area has decreased from 6.17 to 4.71 million ha in the same period. The N surplus in farmland has resulted mainly from applications of chemical N fertilizers and composted manure. The increase in the N surplus from 1961 to 2005 has been mainly ascribed to the increase in N supply from applied manure, which has been estimated to have increased from 143.3 Gg N in 1961 to 433.4 Gg N in 2005 (Shindo et al., 2009).

Other countries around the coast of the East China Sea also face problems related to nitrogen. Both excessive loads from agricultural activities, and point source emissions from untreated sewage cause multiple environmental problems and risks to human health. The challenge of balancing economic growth with human/ecosystem wellbeing is a tremendous task for local, national and regional authorities.

1.2.2 What has prevented N management being addressed in the region before

Very low awareness of the N issues, in both political and public arenas is a fundamental reason N management in East Asia is not better addressed. Furthermore the characteristics of Chinese Agriculture, (i.e., intensive double-crop rotations, small farm size, part-time farmers, and dysfunctional advisory service, etc.) have contributed to a lack of N management within the region.

There are some baseline efforts to increase N fertilizer use efficiency in order to reduce environmental damage within parts of the region (Chen et al., 2014; Liu et al., 2015). These include integrated soil-crop system management (INM) in cereal production systems, in order to produce higher yields of rice, wheat and maize with lower inputs of N fertilizer. Use of enhanced efficiency fertilizers (EEFs) to improve N use efficiency in cropland, vegetable and fruit production systems. Replacing the use of mineral fertilisers with organic fertilisers to reduce the emission of greenhouse gases (GHGs) (Liu et al., 2015), and decrease reactive N losses and soil acidification.

Recent efforts in the wider region include the development of an Ecosystem Health Card for the Laguna de Bay (near Manila, Philippines) as part of the GEF-UNEP Global Nutrient Cycles project. This promoted collaboration between many stakeholders on and around the Laguna bay area. The process that was developed to create the Ecosystem Health Card, is a starting point for future dialogue between stakeholders, regarding causes of excess nitrogen and solutions to impacts.

1.3 Institutional, sectoral and policy context

1.3.1 The main organisations (government and others) involved in N related issues

In China, the main government departments involved in N-related issues are the Ministry of Agriculture (MOA), the Ministry of Environmental Protection (MOEP), the Ministry of Science and Technology (MOST). MOA mainly focuses on food production and optimising N management in croplands. MOEP concentrates on the reduction of air, water and soil pollution caused by reactive N increases; in particular, controlling of agricultural non-point pollution. MOST are chiefly responsible for research initiatives and funding support in N related issues. The National Natural Science Foundation of China also coordinate projects that support basic-science research on the N issue. The Chinese Academy of Sciences (CAS), The Chinese Academy of Agricultural Science (CAAS), and many universities provide the backbone of N research in the region. The Center for Agriculture Mechanization Technology Development & Extension, MOA and a number of Soil and Fertilizer Stations run by local governments ensure policies related to N management are being properly implemented (i.e through provision of guidance, education and training for extension and supervision personnel).

In Japan, the Ministry of the Environment and the Ministry of Agriculture, Forestry and Fisheries are major governmental organizations involved in N related issues. National and prefectural research institutes and universities related to environmental problems are also involved in N related issues.

1.3.2 Main private sector organisations (industry, farmers, etc) and where N used/produced etc

In China, Haber–Bosch N fixation (HBNF), especially the industrial production of N fertilizer, is the biggest contributor of reactive N. It is estimated to be 32.1 Tg yr^{-1}, accounting for 87% of HBNF in

2010 (Gu et al., 2015). Fossil fuel combustion from transport, industry and energy sectors also contributed substantially to NOx increase in China, which was estimated to be 6.6 Tg yr^{-1}. Because most of the N fertilizer is applied to cropping systems, Chinese farmers are still the largest N consumers. According the Chinese Statistical yearbook, nearly 3,200 million tonnes of synthetic N fertilizer are applied to Chinese croplands annually.

In Japan, consumption of N fertilizers in 2012 was estimated to be 433 Gg N yr^{-1}. A large proportion of N fertilizers used in Japan are imported. In 2008, an estimated 107 Gg N in urea was imported, (with 48% and 42% imported from Malaysia and China, respectively). Emissions of NOx due to energy consumption from industries and transportation (vehicles and ships) in 2008 was estimated to be 189 and 376 Gg N yr^{-1}, respectively (Kurokawa et al., 2013).

1.3.3 What national policies are in-place / planned

In China, MOA has been promoting soil testing and fertilizer recommendation programmes since the year 2000. MOA has recently released the next five-year program related to agriculture development. Production and application of high efficiency-formulated fertilizers such as controlled release fertilizer, nitrification inhibitors containing fertilizer and bio-fertilizer are highlighted as important supplements to established soil systems. The ultimate target for the five-year program is a ‘zero increase’ in the use of fertilizers by 2020.

At present, there are no ‘in-place’ or ‘planned’ policies for N management in Japan. Japan’s Science and Technology Agency, The Center for Research and Development Strategy, published a strategic proposal entitled “Consolidated Research Initiative for a Sustainable Nitrogen Cycle” in 2013. It is expected that this will promote N-related policy making. In this regard, the INMS and other international programs, such as The Organization for Economic Cooperation and Development (OECD), will encourage Japanese activities.

While the current core partners of this East Asian Regional Demonstration are within China and Japan, significant engagement will take place with both South Korea and further developing the links to the Phillippines (and through PEMSEA to the wider region).

1.3.4 NGO and CSO activities

At present, there is no clear overview of N management related activities by NGO’s and CSO’s in East Asia. However, NGO’s like WWF do have an interest in nitrogen related issues in this region. Furthermore, it is expected that those activities related to food choice and nature conservation might include N issues, due to the input of relevant information from the INMS regional demonstrations. From the start of the Towards INMS project further NGO/CSO activities in the region will be explored and where possible linked to this INMS Regional Demonstration.

2 Baseline for the East Asia Demonstration in 'Towards INMS'

2.1 Baseline analysis

2.1.1 Previous work that is relevant to the work of this project

Over the last few decades there have been numerous projects that have collected data on various nitrogen related issues in China, Japan and South Korea. This research has been diverse, and has included studies on the impacts of food production, consumption and energy use on the N cycle, and the environmental impacts of excess N at different scales (ranging from microbial processes, to field measurements and catchment and regional scale assessments). Nitrogen flow and footprint analysis have been conducted for China and Japan. But despite significant progress in the last decade in understanding the N cycle, the impacts of excess Nr and better N management, overuse and misuse of Nr is still a serious problem throughout the demonstration region.

Since the 1990's, excess N fertilisers have been applied to Chinese cropland. To optimize N fertilizer use the government implemented a soil testing program and provided guidelines on the amount of fertiliser that should be used in the different regions. However, this program did not effectively reduce fertiliser use. This was potentially due to the current structure of Chinese agriculture (too fragmented with poorly managed small holder farms). Nonpoint pollution from over use of N fertilizers and the decoupling of livestock and human and croplands is causing environmental pollution, from air to water, and from urban to rural areas in many parts of China. To tackle this worsening trend, the central government of China officially launched the 'Action Plan for the Zero Increase of Fertilizer Use' (APZIFU) in 2015. A core aim of this plan is to stop chemical fertiliser increase after 2020, without reducing food production and further deteriorating the environments.

NO_x emissions were not controlled until 2013, in response to a serious 'haze break out' in China. Although SO_2 emissions have been reduced since 2007, PM2.5 pollution (particulate matter with a particle size of less than 2.5 microns) has not significantly decreased. Thus, awareness of NOx pollution, as an important source of PM2.5 pollution, has increased. To mitigate PM2.5 pollution in China, in 2013 the central government launched the "Clean Air Act" (CAA) and listed reductions of pollutant emissions (including SO_2 and NO_x) as obligatory targets for performance appraisals of local governments. Meanwhile, each city has its own goal regarding PM2.5 concentrations to be achieved by 2017. These are based on the CAA, and are generally 10-25% lower than 2012 levels.

To control the water pollution, the central government launched a series of water specialist projects, such as the Taihu Lake water project. This project has made a 6 billion Yuan investment to improve the water quality in Taihu Lake. Although these projects worked to some extent, the problem has persisted and algal blooms still occur. Point source pollution has been easier to control, whilst little achievement has been made to reduce diffuse pollution. To better manage water pollution in China, in 2015 the central government launched the "Clean Water Act". Targets were made to mitigate nonpoint pollution from cropland, livestock, and sewage from rural settlements.

In Japan, the Basic Environment Law establishes environmental quality standards for air and water (rivers, lakes, coastal seas, and groundwater). Although achievement of environmental quality standards is not legally mandated, it is used as an indicator of the efficacy of countermeasures designated to reduce emissions of pollutants.

In China, The Air Pollution Control Act (enacted in 1968) uses emission standards to regulate air pollutant loads from point sources (e.g., fuel combustion facilities and waste incineration facilities) and mobile sources (e.g., automobiles and ships). Additional regulations based on the Act Concerning Special Measures for Total Emission Reduction of Nitrogen Oxides and Particulate Matter from Automobiles in Specified Areas (enacted in 1992) apply to designated areas such as megacities to control air pollution (NOx) from automobiles. Pollution loads from point and mobile sources are regulated by emission standards based on the Air Pollution Control Act. Local governments (prefectures and cities) can set more-stringent standards according to the local conditions. The Ministry of the Environment has monitored atmospheric deposition including N deposition since the 1980's. Nowadays, the national monitoring for atmospheric deposition is also linked with the Acid Deposition Monitoring Network in East Asia (ACAP 2015).

The Water Pollution Control Law is the fundamental law governing water quality conservation in Japan. Additional laws have been adopted to control regional and local water pollution, such as the Law Concerning Special Measures for Conservation of the Environment of the Seto Inland Sea and the Law Concerning Special Measures for Conservation of Lake Water Quality. Pollution loads due to discharges from point sources such as industrial facilities are regulated by effluent standards. The effluent standards promulgated by the Water Pollution Control Law are uniform throughout the nation, and they take into consideration natural purification that occurs in water bodies. However, the uniform standards are not sufficient in areas with high pollution loads (e.g., megacities and industrial complexes), and stricter regulations are required. For these areas, local governments (prefectures and cities) set more stringent standards for discharges to control pollution loads according to the local conditions.

In Japan, other laws relating to water quality conservation are the Water Supply Act, the Sewerage Act, the Private Sewerage System Act, the Act for Promoting the Introduction of Sustainable Agricultural Production Practice, the Law on Appropriate Treatment and Optimization of Livestock Manure, and the Sustainable Aquaculture Production Assurance Act.

In Japan, effluent standards have been set for point sources, such as livestock facilities. Similar effluent standards have not been set for croplands, which are non-point sources. However, for N, the Code for Agricultural Practice in Harmonization with the Environment promotes reduction in the use of chemical fertilizer and increases in the use of organic fertilizer; both of these measures are effective ways to reduce N loads to water bodies through N leaching from croplands.

In China, the majority of research programs addressing nitrogen issues (of local, national and regional scales) have been mainly funded by MOST, MOA, NNSF. The Chinese scientists involved in the INMS project participate in many national research projects and networks, and have established long-term cooperative relationships with related domestic universities and research institutes. Furthermore, multiple partners have collaborated extensively with Germany, Netherlands, Norway and the UK.

2.1.2 Relevant activities undertaken to 'manage' N

Projects conducted by China within the demonstration region with relevance to nitrogen issues include:

- *Control of nitrogen pollution in intensive agricultural area* (Key project of national ten-fives plan, Ministry of Science and Technology, grant No.2002BA516A01, 2001-2005)
- *Nitrogen cycling, behaviour and its environmental effects in main agroecosystem of China* (Key NNSF project, grant No.30390080, 2003-2007) A major project focusing on agricultural

ecosystem behaviour and nitrogen efficiency from 2003 to 2007, these programs were granted by National Natural Science Foundation of China (NSFC)

- *Integrated control of N & P pollution in intensive cropping systems in Northern China* (Key project of national eleven-fives plan, Ministry of Science and Technology, grant No.2006BAD17B05, 2006-2010)
- *Monitoring of nonpoint source pollution from agriculture on field and watershed level*; *Prevention and control technology of nonpoint source pollution from agriculture*
- *Policy development of strategies for NPS prevention and controlling*. The sources of reactive N and its effects on air quality and climate change in China (on-going 973 program (2014CB953803) of the Ministry of Science and Technology of China(2014-2018)]
- Sino-British project for improving soil nutrient management towards a low carbon economy in China.

In Japan, the Ministry of the Environment (MoE) finances the Environment Research and Technology Development Fund, and the Japan Society for the Promotion of Science (JSPS) finances Grant-in-aid for Scientific Research. Japan Science and Technology Agency (JST) and New Energy and Industrial Technology Development Organization (NEDO) also provide funding for applied research of environmental issues, not regularly but occasionally involving N issues.

Here we plan a demonstration network on nitrogen issues for East Asia. This will enable the development of a methodology for the whole region that encompasses the relationships between agricultural, combustion and wastewater related activities, losses to the environment, impacts and the effect of measures in terms of (cost) effectiveness and will form the basis for different scenarios. This network will start using available knowledge and expertise in China and Japan, involving South Korea and The Philippines as the activities progress.

The different scenarios will then feed into policy making with respect to agriculture, energy and the environment. Using the state of knowledge that has been developed in this way, it will be possible to assess and optimize the potential for food and energy production/security while minimizing the environmental impacts. This will be developed using quantification of different scenarios.

The experience from other countries and the networks that have been set up to address multi-disciplinarily in N management will be of great value to the East Asia research groups. This will lead to major advances in the following areas:

- Emission processes
- Dispersion, transport, deposition of air pollutants
- Water losses, transport and sedimentation
- Biomass and food production systems; resource efficiency
- NUE in different sectors
- Climate
- Environmental and human health impacts
- The cascade of nitrogen into the environment
- Socio-economic drivers of the nitrogen cycle
- Impact assessment and cost-benefit analysis
- Scenarios
- Policy development in environmental impacts, resource efficiency, climate action
- Communication

2.2 Gaps

2.2.1 What are main gaps in the region with respect to:

2.2.1.1 N policies and N practices

Through a comprehensive approach, Smith and Siciliano (2015) have identified many factors that constrain improvement in fertilizer management and mitigation of N emissions in China. These include drivers of poor nutrient management that derive from deficiencies in policy approaches, as well as from economic and social structural characteristics and dynamics of the rural economy. The analysis confirms that N problems cannot be addressed by single regulatory or policy measures alone. There is a need to develop a mitigation framework that encompasses clear policy directives from central government, facilitating governance arrangements at local level, an enabling regulatory environment and horizontal and vertical coordination in food supply chains. Incentives for the protection of water resources, air and soil by farmers (unbiased by other sector policies), enhanced agricultural food safety and environmental education for both farmers and consumers is also required.

Lack of adequate, reliable and universally accessible urban and rural social security systems come at the cost of agricultural efficiency and environmental impact. Positive trends are identifiable in a number of relevant respects. For example, the 12th five year plan (2011–2016) of China emphasizes the need for environmental quality improvement in rural areas (Li et al., 2013). The gap between environmental regulation and enforcement may also be closing ('re-coupling') through shifts in government priorities and leader incentives, governmental re-organization, and increasing pressure for transparency and monitoring (Burns and Zhou, 2010; Marquis et al., 2011; Economist, 2014b). Improvement will inevitably take time and be uneven, and will require capacity building at county and township levels (FORHEAD, 2014).

There is also a strong consensus emerging that increasing the scale of production can help in addressing environmental impacts (Shen et al., 2013; Garnet and Wilkes, 2014). The 2013 'Number One Document' of the Chinese Government envisaged strengthening of land rights as a means of supporting development of large-scale family farms. Agricultural cooperatives and other recent policy announcements indicate that further reforms of land rights may enable farmers to transfer or mortgage contracted land and convert land use rights into shares in large-scale farming operations (FORHEAD, 2014). Concentrating nutrient management in larger-scale farm operations will facilitate application of precision management techniques, investment in waste facilities (e.g., manure management systems), and will facilitate both provision of extension advice and the monitoring of guidelines and regulations. Mechanisation associated with large holdings can address scarcities of agricultural labour that contribute to deficiencies in farm management. Furthermore, farmers are becoming ever-more self-organising, creating the potential for new institutions for agricultural and rural development (Huan et al., 2010). However, more research is required to understand the environmental impacts of production at different scales and in different management systems, with and without integration of crop and livestock production. More research is also needed on how supply chain coordination strategies can be developed for different commodities, in ways which can benefit farm incomes, consumer standards and the environment.

Nitrogen policies of the government of Japan are focussed on reducing respective environmental pollution, e.g., air, water, groundwater, and coastal water, rather than pro-actively preventing them. Causative national policies to comprehensively control N issues are necessary to maximize the N benefit and simultaneously minimize the N threat. In Japan, NH_3 is excluded from airborne emission controls, which may be an important environmental issue in the near future.

The INMS will help to further develop the research infrastructure and management systems in the East Asia region related to agricultural, energy, environmental and climate research. Nitrogen research in these areas has started in past decades in China and other countries of the East Asia region. Research has been mostly focused on increasing agricultural productivity and the environmental impacts. The integration and multi-disciplinary approaches needed to understand the complex interactions between actors, compartments, impacts and scales are essential in nitrogen research. This multi-disciplinarity needs the cooperation and integration of existing research areas into new ones. This requires high quality research in areas, where natural sciences can meet socio-economic sciences.

International policies in East Asia are also necessary to monitor and evaluate the N status of the atmosphere, hydrosphere, pedosphere, and biosphere, and to control the N issues in this region in close cooperation with relevant countries.

2.2.1.2 Scientific understanding

Nitrogen is a crosscutting theme over most of the important environmental problems, i.e. climate change, biodiversity, ecosystem health, human health, ground water pollution, etc. While addressing nitrogen problems within these themes, there are obvious benefits if these problems could be considered in an integrated way and not as isolated phenomena. Such an approach would increase the possibility of finding more (cost) effective solutions to both the unavoidable use of N in agriculture and the development of the abatement strategies. Before this target is reached, however, we face a period where our scientific understanding of the interactions and feedbacks are limited and further developments are needed. This makes a multidisciplinary approach necessary, in order to understand the different drivers of the nitrogen cycle and the means and options to influence them (i.e. technology, management, policy). In doing so, we can formulate and quantify different future scenarios.

In Japan, reduction in chemical fertilizer application rate is still insufficient for some specific crop types (typically, green vegetables and tea). Recycling of livestock manure, crop residues, and wasted food for use as organic fertilizer is also insufficient in Japan. For industrial and transportation sectors, emissions of NOx are well controlled both for point and non-point sources. Recently, the environmental standard of NO_2 concentrations was achieved, even in the Tokyo metropolis. However, the environmental standards for PM2.5 and tropospheric ozone were not achieved in many areas.

Effluent standards have been set for point sources. Effluent control in the industrial sector has been well achieved. However, agricultural point and non-point sources (i.e., livestock facilities and croplands applied with N fertilizer) have occasionally caused nitrate pollution resulting in eutrophication of receiving waters. Public awareness of N issues is still low, particularly with respect to knowledge about the strong linkage between food consumption (food choice) and N loss to the environment.

Quantitative data of N loss to the environment are still insufficient, excluding NOx emissions from energy consumption. Further research is needed to fully understand the complex behaviour of reactive N once it is emitted to the environment. Furthermore, the impact that elevated CO_2 levels in the atmosphere and climate change have on the N cycle is still relatively unknown, and provides uncertainties in future predictions.

2.2.1.3 Funding for these

In East Asia, finding funding for a comprehensive N assessments and awareness raising work is can be difficult. In comparison, funding for fundamental scientific research that does not focus only on N, is a lot easier to find.

2.3 Stakeholder analysis

2.3.1 Who are the main producers/users of N

Industry is the main producer of anthropogenic N_r through the Haber-Bosch nitrogen fixation (HBNF) and fossil fuel combustion, and agriculture is the main user of HBNF as N fertilizer.

2.3.2 Who are the main stakeholders

Effectively managing the environmental impacts of changes in the farming sector will require not only integrated policy measures but also the engagement of multiple actors beyond government. Thus NGOs, the media, water suppliers, industry and consumers can all play important roles in developing a comprehensive mitigation framework for N pollutions. At the centre of the mitigation framework must be policies to give farmers economic incentives to raise fertilizer use efficiency and make it possible for them to adopt the most efficient technologies (Zhang and Powlson, 2012). In turn this must be supported by an adequate scientific knowledge base.

2.3.3 Role of the government in N management

The challenge for the future will be to grow more food and to provide the protein for feeding a growing population with a changing diet, whilst re-establishing and preserving environmental health. Furthermore, the growing demand for energy asks for a transition from fossil fuels to other types of energy, to prevent increasing N_r losses to the environment. Without any further changes, this will require a large increase in nitrogen fertilizer use, which may then subsequently cause substantial N-losses from crop and livestock production facilities. This may then increase the pressure on the environment, human health, climate and ecosystem services. It is therefore very relevant to study the possibilities of increasing food production and energy use while minimizing losses of nitrogen to the environment. Related stakeholders will be e.g. livestock production industries and government departments such as Ministry of Agriculture, Ministry of Environment.

3 Project Description for the East Asia Demonstration in INMS

3.1 Strategy

3.1.1 General information

The work plan described in this Appendix forms part of the overall execution of INMS Component 3 on the Regional Demonstration of the Full Nitrogen Approach. The rationale for this broader approach is described in Appendix 17. The development of a common strategy to all the Regional Demonstrations in INMS is an iterative process and has already benefited from engagement at three workshops during the PPG Phase (February 2015, Japan; March 2015, Germany; April 2015, Lisbon). This strategy aims to a) provide sufficient common approach to allow comparability between the different regional demonstrations, especially when synthesizing and applying the results (Activities 3.2-3.4; Activities 2.2-2.4), b) provide sufficient scope to allow regional priorities to be addressed according to the different regional needs.

As a developing area with excessive N_r, the initial stage in developing a strategy for better N management is to quantify the N fluxes in all related subsystems (cropland, forest, atmosphere, hydrosphere, etc.). Then assess the benefits of nitrogen use within each subsystem, on food production and other human welfare, against the costs to the environment, ecosystems, and human health. Based on these assessments, identification of the socioeconomic barriers that inhibit mitigations and adaptations will provide understanding as to how we can achieve a better future through N management.

As a large area, East Asia includes many countries, seas and oceans. The East Asian demonstration area will connect the countries in East Asia, including China, Japan, South Korea and the Philippines. These countries represent a variation in the economic development, population, country area and N_r production/use. Thus, these countries should be able to represent N cycling in the entire East Asia region. Although the whole area is considered as a developing area, some countries are more developed than others, such as Japan and South Korea, where excess N_r is applied to cropland. Thus, analyses of the relationships between socioeconomic development (including policies, technologies, cultures, etc.) and N_r use, may help in understanding N cycling in the region. Meanwhile, China is a large country with enormous variations in both its N_r use and pollution, especially between Eastern and Western parts. Natural conditions such as climate are very different within and among these four demonstration countries. This may provide a natural cause of variation in the N cycling among the countries. These variations provide a good research gradient on N_r use and impacts, and will result in different priorities for N_r management.

On the basis of national N budget studies the demonstration will estimate how much Nr is transferred to the ocean through river export and atmosphere deposition. This can help to assess the changes of Nr levels in the open ocean of East Asia. Nr inputs to coastal waters and open oceans are crucial, and N is often the limiting nutrient within their ecosystems. Thus, monitoring of N input to estuaries, and N deposition in coastal waters and open oceans, is essential to test whether estimated N input to our oceans based on national budgets is accurate. This is important to protect the health of open oceans. This is especially relevant to the Western Pacific Ocean which currently receives significant N inputs from prevailing winds, which carry pollutants from China, Korea, and Japan to the Pacific Ocean, and even North America. The Tibet Plateau blocks most pollutant transfer from other countries in the west, such as India. Countries in East Asia have to work together on the monitoring and calculation of N loading to the ocean. This also links to the protection of ocean environment and natural fisheries, especially for Japan and the Philippines. Changes of ocean environment can impact aquatic biodiversity and promote climate change through acidification derived from excessive Nr inputs. This may also trigger the anammox process with potential impacts to regional N cycling.

3.1.2 Outputs and activities

The INMS project will improve understanding of the global/regional N cycle and investigate/test practices and management policies at the regional, national and local levels. A key aim of this work will be to reduce negative impacts of Nr on the ecosystems, environment and human health. As a region with excessive Nr and the largest Nr use worldwide, East Asia needs to be well informed on how to manage N. Implementation of N management strategies are needed that address negative effects of excess Nr whilst not impacting economic development. A demonstration activity, which delivers conclusions refining approaches to national/regional assessments and improves understanding of regional N cycle, will address these challenges and provide opportunities for East Asia.

To achieve these outputs, we have to design a common methodology for our regional demonstration to refine regional Nr assessments and improve understanding of the regional N cycle. This is important since a common methodology would insure that the results from different regions are comparable. This is of course the basis of a global N assessment and global N management. First of all, we have to obtain good quality data on both human activities and N cycling parameters. This will require the examination of the N flows by source, sector and loss pathway, at different scales. To identify and quantify uncertainties further focused monitoring at a smaller scale maybe required.

Once we have reliable measurements for N fluxes, cost-benefit analysis (CBA) is needed to identify and quantify key threat/benefit priorities with policy stakeholders. This is an essential linkage between N cycling and policy makers. Quantifying negative effects of excess N use is especially important, especially in China as the largest consumer of Nr in the world. This will be key in convincing policy makers to implement measures to improve N management. For the CBA, monetization is a good way to quantify impacts; however, large variations exist because it is difficult to determine how much these negative effects will cost. 'Willingness to pay' is often used to solve this issue, but its accuracy is often a source of debate. As such the use of others indicators to describe negative effects may be needed. We also need N performance indicators such as the N footprint and N labelling, used in co-operation with global analysis (Component 1) and comparison with different nations and regions (other Demonstrations in Component 3).

With all the above-mentioned analysis, we will move to the final step; taking actions to reduce the negative effects while maintaining or increasing the benefits. Owing to the variations in socioeconomic development across nations and regions, we would need to review the available options for mitigation/better N management and co-benefits/trade-offs. Different options may have different effects in different nations/regions. Although natural conditions may be in part responsible for variations, socioeconomic constrains will also play an important role. To achieve the final step, collaboration with social scientists is essential in order to help identify the barriers to change for stakeholders, governments and the public, at local, national and regional scales.

3.1.3 Linkages with GEF and non-GEF interventions

There are several projects from GEF and other organizations in the East Asia region, which have linkage with this demonstration. Summarized in the following table, the demonstration activity will seek to engage with as many of these projects as relevant and feasible.

GEF Interventions				
GEF ID	**Project Name**	**Region**	**Completion Date**	**Linkage with this project**
2700	Implementation of Sustainable Development Strategy for the Seas of East Asia (SDS-SEA)	Asia and the Pacific	2012-03-31	Provided information on the assessment of ocean environment in this region
2138	Livestock Waste Management in East Asia	Asia and the Pacific	2011-12-31	Provided information on the livestock waste management measures
5452	Guangdong Agricultural Pollution Control	China	Under Implementation	Provided information on Nr uses in tropical and subtropical regions
3223	Shanghai Agricultural and Non-Point Pollution Reduction project (SANPR)	China	Under Implementation	Provide information on N pollution controls in coastal regions
2135	Guangdong - Pearl River Delta Urban Environment	China	2011-12-31	Provide information on pollution controls in urban regions in China
1105	Efficient Utilization of Agricultural Wastes	Asia and the Pacific	2010-08-23	Provide information on nutrient recycling in agriculture
Non-GEF Interventions				
Project NO.	**Project Name**	**Region**	**Completion Date**	**Linkage with this project**
	Zero increase plan of nitrogen fertilizer use	China	Under Implementation	Provide information on policy analysis on reduction of excessive fertilizer
2014CB953803	Climatic effect of Nr emission	China	Under Implementation	Provide information on Nr emission to the atmosphere and their climatic effects on national scale
2014CB954400	Nitrogen cycling in forest ecosystems and their environmental effects	China	Under Implementation	Provide mechanisms of N cycling in forest ecosystem
2014CB953700	Atmospheric deposition impact on marine nitrogen cycling and primary production process and its climatic effects	China	Under Implementation	Provide information on terrestrial N_r emission and deposition to marine ecosystems and their impacts on climate
KAKENHI 26252061	Effects of nitrogen on carbon cycle in paddy ecosystem under climate change	Japan	On-going	Impacts of climate change on N dynamics in paddy ecosystems
	Japan Long-Term Ecological Research Network	Japan	On-going	Provide long-term and large-scale data of N cycles in various ecosystems
	GRENE (Green Network of Excellence) environmental information project	Japan	On-going	Provide nationwide soil N pools and dynamics in forest ecosystem

	ReSIN: Regional and comparative Soil Incubation study on Nitrogen dynamics in forest ecosystems project	Japan	On-going	Provide pattern and process of N dynamics of forest soil under changing climates
	Japanese N Calculator: N footprint assessment project	Japan	On-going	Provide average per capita N footprint in Japan and the analytical tool

3.2 Project Sub-components and activities

The Project Objective and Outcome under which this Demonstration Activity sits, is provided below:

Project Objective: To improve the understanding of the East Asia N cycle and investigate practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems

Outcome 3.1: GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient Nr, ensuring that any negative effects are minimised

The following figures (A17a1 to A17a3) detail the Task and Interim Task Outputs which will lead to the fulfilment of Activity 3.1 and the delivery of Output 3.1 for the East Asia demonstration. In essence it shows how the demonstration activity is conducted step by step from quantifying N fluxes to scenario analysis for mitigation. Owing to the large variation in N cycling and local natural conditions across East Asia, related institutions and scientists in each demonstration country should first conduct studies separately. Some international databases such as FAOSTAT provided by FAO can supply some data on Nr sources for all the countries. Although local information will still be needed to conduct a full analysis. Thus, for the following steps, activities should be based on national scale studies (except where work needs regional collaboration such as the N cycling in oceans).

The first step will be to review previous studies on Nr sources and losses, gather background information on how the Nr is used, and losses in the East Asia demonstration countries. National N budgets are needed to quantify the Nr sources, cycling and loss pathways. Mass balance and modelling methods are commonly used to conduct budget studies and require at least two sets of data: human activities (e.g., population, fertilizer use, land area, food consumption, food production, etc.) and N cycling parameters (e.g., biological N fixation rate, denitrification potential, NH_3 emission rate, etc.). The first set of data is easy to access from national or international statistics database; the second set of data is difficult to obtain and large variations exist because many factors (temperature, precipitation, soil texture, etc.) affect the N cycling on national and regional scales. This is especially relevant to China and Japan which are located in various climate zones. Therefore, literature review for these local/national/regional N cycling studies are essential, in order to compile an accurate database on the N cycling parameters. These two databases should be shared with the participants in the INMS, or at least with the regional demonstration participants. If there is no such database available, data and parameters from international database and global scale parameters can be used initially, and further refined in the following steps. For China, Zhejiang University has just led and finished the national N budget and published the paper in PNAS (Gu et al., 2015). Although this work has supplied a useful example on doing the national N budget, uncertainty analysis in this study is not sufficient, and more work will be needed to ensure accuracy.

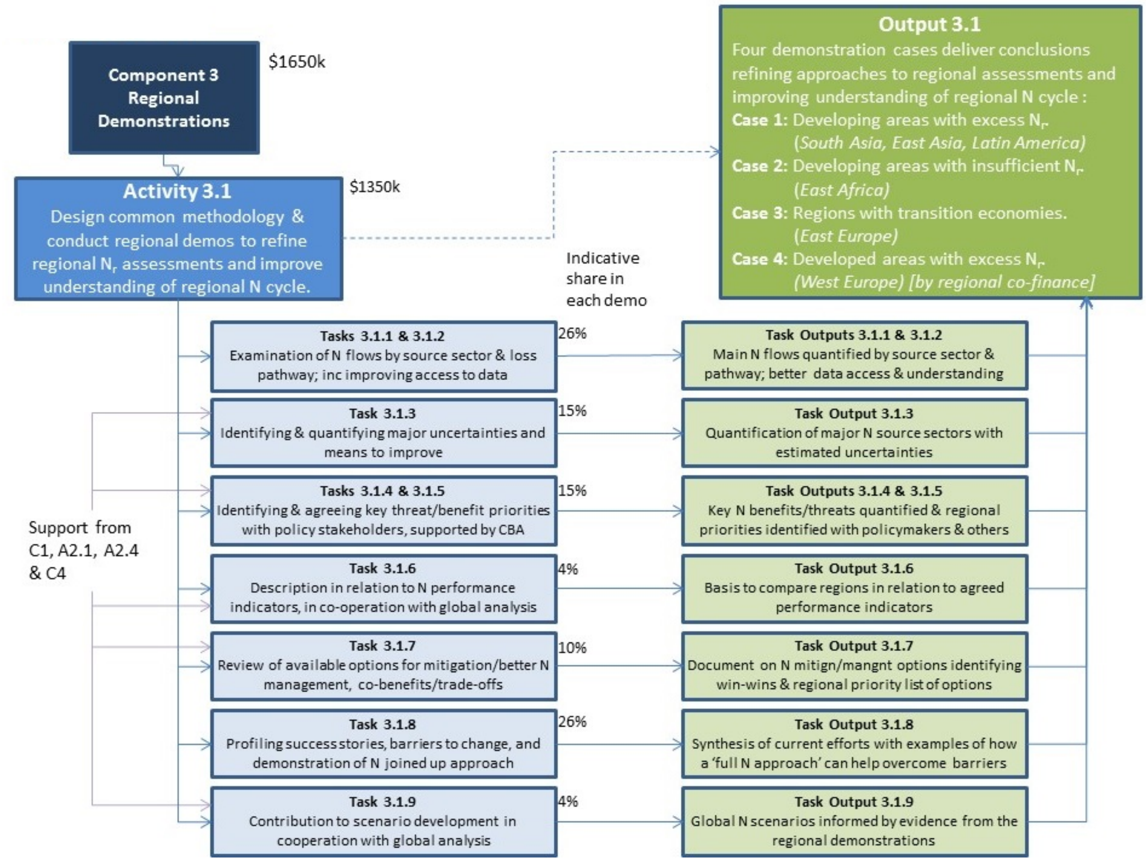


Figure A17a1: *Activity 3.1 of the demonstration activity, split by Task and Task output.*

Uncertainty analysis of the N fluxes are an important step for further work. It is difficult to conduct uncertainty analysis for the national N budget because of the complex interactions between fluxes within the N cascades. Although Monte Carlo simulation is commonly proposed as a method to study the uncertainties of N cycling, usually only one flux is assessed, such as N_2O emissions. Therefore, development of new tools to conduct uncertainty analysis for a national N budget is essential in this project. A Dynamic Integrated Budget-Tool (dynIB-tool) proposed by Adrian Leip from the Joint Research Centre, (Institute for Environment and Sustainability, Italy) may provide the solution to this. Until this is possible, rating N fluxes by classifying them into broader groups with different uncertainty ranges may be of help.

Once we have completed the national N budget for all the demonstration countries, CBA will need to identify and quantify the key threats and benefits and decide priorities for policy stakeholders. The European N assessment has developed a standard method on the CBA; however further local information would be needed to conduct the CBA. Compared to the EU27, East Asia is less developed, thus the key parameter of 'willingness to pay (WTP)' is likely to be much lower than that found in EU27. Quantifying the WTP for e.g. environmental and health costs, which is assessed using a social survey, still needs to be done in East Asia. We can apply the same method to conduct the survey, and even use similar questionnaires (to those used in EU27 countries) to make the results comparable. There are several good social survey centres in China and other East Asia countries, such as the Peking University, Zhejiang University. Collaboration with these centres is necessary for the

CBA study. Under the support from CBA, it is possible to identify and agree on the key threats and benefits and priorities for policy stakeholders.

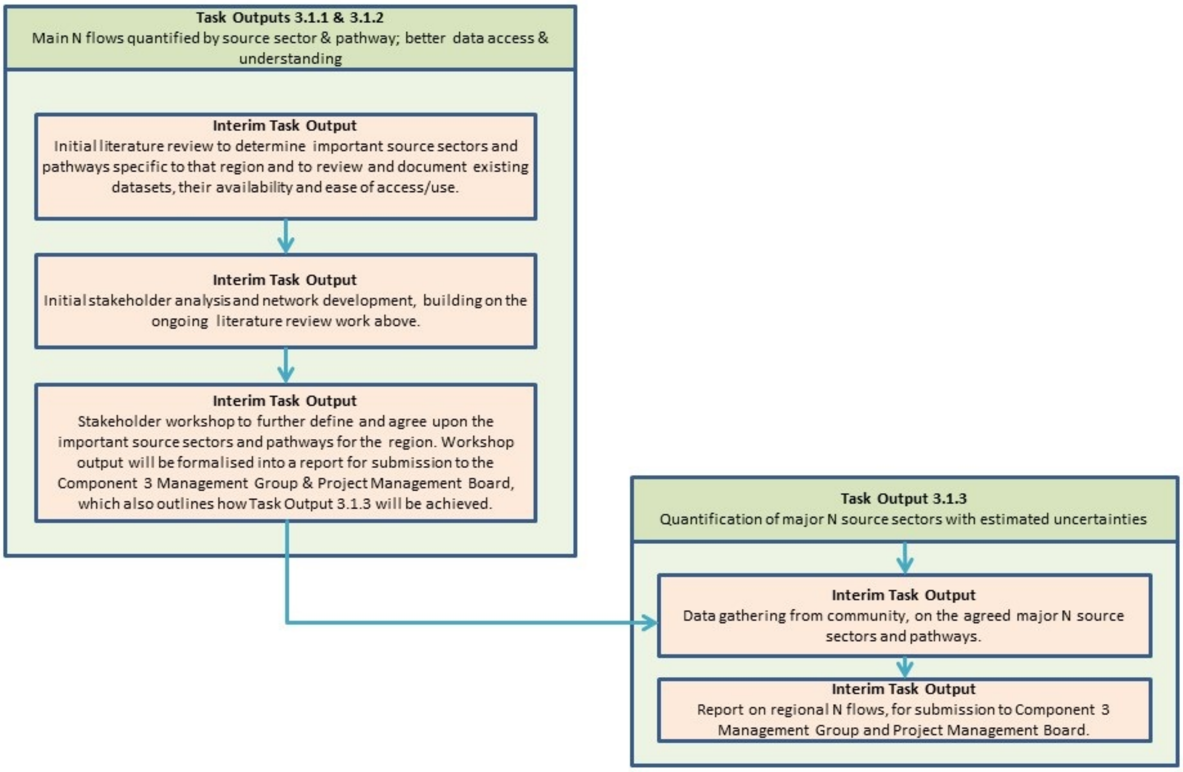


Figure A17a2: *Interim Task Outputs for Task Outputs 3.1.1, 3.1.2 & 3.13 and how they are linked.*

To be comparable with other world regions, N performance indicators will be built following a standard procedure agreed in co-operation with Component 1. Many terms can be used as indicators such as subsystem NUE, N footprint, N labelling, net cost-benefit ratio, etc. These indicators are easy to calculate once national N budget is completed. However, indicators must be clearly defined using standard calculation procedures. For instance, the N footprint has been widely used recently, but there are at least two methods to calculate the N footprint, one by the N-Calculator model and one by mass balance.

The International workshop *"Nitrogen footprint: Local reality and global connection"* was held in March 2015 in Japan and a synthesis paper *"Nitrogen footprints: Regional realities and global connections for reducing anthropogenic nitrogen losses to the environment"* is in preparation. Other N indicators were also discussed at this workshop. The East Asia demonstration can contribute to the development of this topic at the global scale, in collaboration with Activity 4.2.

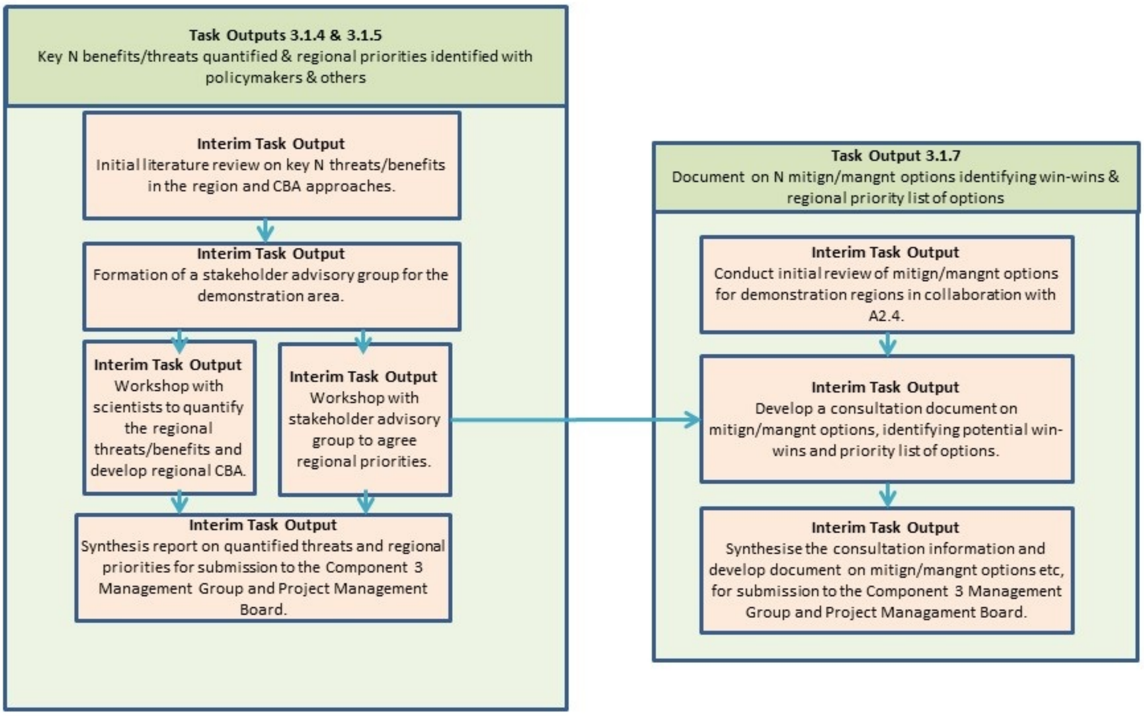


Figure A17a3: *Interim Task Outputs for Task Outputs 3.1.4, 3.1.5 & 3.1.7 and how they are linked.*

A multidisciplinary effort is needed to identify mitigation measures. This will be based on the CBA calculation and key threats identified in the project, and combining with a review of regional studies to build pathways and measures on how to reduce the excessive Nr loss in East Asia. These measures can be compared with measures that are already implemented in developed regions with excessive Nr, such as Western Europe. These comparisons can help select the most effective measures. These measures include NUE improvement, increasing the recycling of nutrients, and dietary changes to consumption of animal protein. To quantify the effects of these measures, scenario analysis may need to be conducted. Then CBA can be carried out to assess whether implementing different mitigation measures has net benefit. The results of CBA would require linkage between science and policy. During this stage, social scientists and economists may be required in order to better quantify the policy related costs and benefits.

However, although policy analysis has been involved in the development of mitigation measures, the implementations of measures (policies, technologies, etc.) may still have other socioeconomic barriers that may not be captured by cost-benefit analysis. These barriers can refer to institutional changes, economic development pathways, culture, public education, etc. Thus, beyond the economists, social scientists will be important. Many universities (e.g., China Agricultural University, Zhejiang University, etc.) have social science departments. Because barriers will vary between demonstration country, each country will require its own analysis. This will be conducted in co-operation with Activity 1.6 to bring together different views between regions.

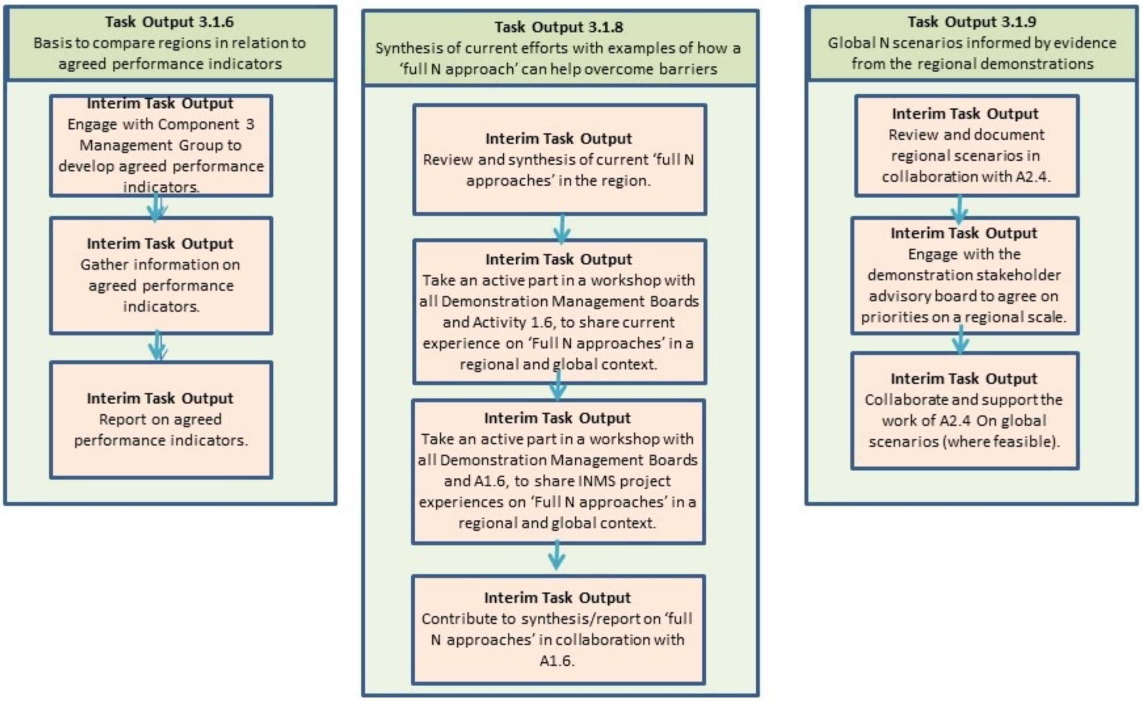


Figure A17a4: *Interim Task Outputs for Task Outputs 3.1.6, 3.18 & 3.1.9 and how they are linked.*

The regional demonstrations will report their results to the Component 3 Management Group during the project. Further interactions with the rest of Component 3 activities and the other regional demonstrations, will be the sharing of results and experiences through workshops and meetings. The outcome will also feed in to inform developments in Component 2 in, A2.2 – global consolidated assessment & A2.3 - methods for better N management. Final reports from the demonstration activities can then be developed in collaboration with Component 4 and submitted to national related departments to benefit global sustainable development.

3.3 Budget and co-financing

3.3.1 Budget

The budget breakdown by cost type and by tasks is listed in Tables A17a1 and A17a2. In summary, the total budget is 270, 000 USD for 4 years. The first part of the budget (108, 000 USD) is to support the East Asia regional team in China, including the cost for the Regional Co-ordinator in China and one funded Project Officer in China as well as the additional office and admin costs. The Chinese regional office will work in partnership with the Japanese regional office (consisting of a Regional Co-coordinator and a Project Officer), however the staff time for this activity will be supported through co-financing from Japan. The second part of the budget (135, 000 USD) is to support meetings or workshops, including travel and venue costs, preparing communications, reports and experiences.

Table A17a1: *Budget breakdown by cost type*

Cost Type	Cost per year (USD)	Cost for project [4 years] (USD)	Notes
Establishing and supporting a regional team			
Regional Co-ordinator	12,000	48,000	Assuming 60 working days per year with salary of 200 USD per day
Project Officer (post-doc level)	14,000	56,000	Assuming 140 working days per year with salary of 100 USD per day
Office and admin costs (including printing budget for dissemination materials)	2,200	8,800	Covering all additional costs
Total	***27,000***	***108,000***	
Support for meetings (including travel and venue budgets, preparing communications, reports and experiences)			
Travel & Subsistence Costs	25,000	100,000	Assuming 20 person travels per year with each travel cost 1000 USD plus 250 USD as subsistence on average
Venue and Catering Costs	6,500	19,500	Assuming venue cost 5400 USD and catering cost 1100 USD per year
Preparing reports etc.	2,250	6,750	
Total	***33,750***	***135,000***	
Additional bought in Services (e.g. to supplement key datasets, additional necessary information etc)			
Total	***6,750***	***27,000***	
Total for Demonstration	**67,500**	**270,000**	

Table A17a2: *Budget breakdown by Task*

Task	Cost (USD)
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	70,200
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	40,500
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	40,500
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	10,800
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	27,000
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	70,200
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	10,800
Total	**270,000**

3.3.2 Co-financing

The current overall co-financing is 1,035,000 USD for the East Asia region, in Component 3. This builds on co-financing from Chinese and Japanese sources. The expectation is that, after the start of the project, other countries will start participating further. It is expected that this will then add to the total co-financing for this regions. China's total co-financing support in Component 3 equals 815,000

USD, which comes mainly from Institute of Soil Science of Chinese Academy of Sciences (ISSCAS)) and China Agricultural University (CAU-Soil and Crop) Japan's total co-financing support is 220,000 USD with main contributions from National Institute for Agro-Environmental Sciences (NIAES), Field Science Center for Northern Biosphere, Hokkaido University (FSCNB-HU), National Institute for Environmental Studies (NIES) and Kyoto University (KU).

Table A17a3: *Co-financing budget, listed by Task and Partner*

Task	Co-financing (USD)	Partner
Activity3.1: Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N cycle	855,000	ISSCAS, NIAES, CAU-Crop, CAU-Soil, FSCNB-HU, NIES, KU
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	395,000	CAU – Crop,CAU-Soil, ISSCASNIAES, FSCNB-HU, NIES
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	205,000	CAU-Crop,ISSCAS, NIAES, FSCNB-HU
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	65,000	CAU-Crop, NIAES
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	28,000	ISSCAS, NIAES, KU
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	21,000	ISSCAS, NIAES, KU
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	121,000	CAU-Crop, NIAES,KU, China ISSCAS,
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	20,000	NIAES
Activity/Task 3.2: Contribution to scenario development in cooperation with global analysis	180,000	CAU-Crop, ISSCAS, NIAES
Sum of co-financing support Component 3	**1, 035,000**	**All related Institutions**

3.4 Work Plan

The Work plan is detailed below, described by Task, for Activity 3.1. It is noted however that after the project starts, a review of all demonstration work plans will occur, and an agreed timetable (across the whole of Component 3) will be presented to the Project Management Board and Project Partners Assembly for endorsement at the Inception meeting.

	Year 1				Year 2				Year 3				Year 4			
Activity and Sub-activities Description	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Component 3: Regional Demonstrations																
Activity 3.1 Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N cycle.																
Task 3.1.1 & Task 3.1.2, "Examination of N flows by source sector & loss pathway; inc improving access to data																
Task 3.1.3, Identifying & quantifying major uncertainties and means to improve																
Task 3.1.4 & Task 3.1.5, Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA																
Task 3.1.6, Description in relation to N performance indicators, in co-operation with global analysis																
Task 3.1.7, Review of available options for mitigation/better N management, co-benefits/trade-offs																
Task 3.1.8, Profiling success stories, barriers to change, and demonstration of N joined up approach																
Task 3.1.9, "Contribution to scenario development in cooperation with global analysis																

3.5 Sustainability

The activities of the East Asia regional demonstration can be refined at different levels after the project is finished. For example, nitrogen flow and assessments can be done for the major agricultural regions of China such as the north China plain and Taihu Lake region. The capacity building of key actors such as industry and local and national government officials will strengthen the long-term sustainable management of nitrogen, especially agricultural nitrogen. The collaborations among East Asian countries formed in this project will facilitate future communication on common environmental concerns. This does not only hold for the currently proposed countries (China and Japan), but also for the countries where further engagement is planned (e.g. South Korea, The Philippines).

3.6 Replication

As one of the five regional demonstrations in INMS, the East Asia demonstration will involve many stakeholders including private sectors and raise public awareness. These kind of activities are relatively new in this region, although examples exist for relevant activities (e.g. earlier mentioned Heath Card for the Laguna de Bay in the Philippines). Therefore, this demonstration area provides a model for future activities, at local, national or regional levels.

3.7 Awareness raising, communications and dissemination

Participants of the project will make appropriate presentations at relevant scientific conferences, workshops and other stakeholders. Special efforts will be made to communicate scientific views to the public, including open seminar and reports in mass media. Among project participants, web-based instant communication groups will be established. Except annual workshops, regular virtual meetings will be held to exchange progress. Datasets resulting from the project will be shared among participants and incorporated into the overall INMS databases. Scientific findings will be published in academic journals in addition to the key INMS consolidated reports and in co-operation with Components 1, 2 & 4.

3.8 Execution arrangements

The regional demonstration activities will be conducted under the auspices of INMS Project Management Board (PMB) and the Project Co-ordination Unit (PCU), which will oversee the regional activities and also facilitate communications between this demonstration region and other demonstration regions of INMS.

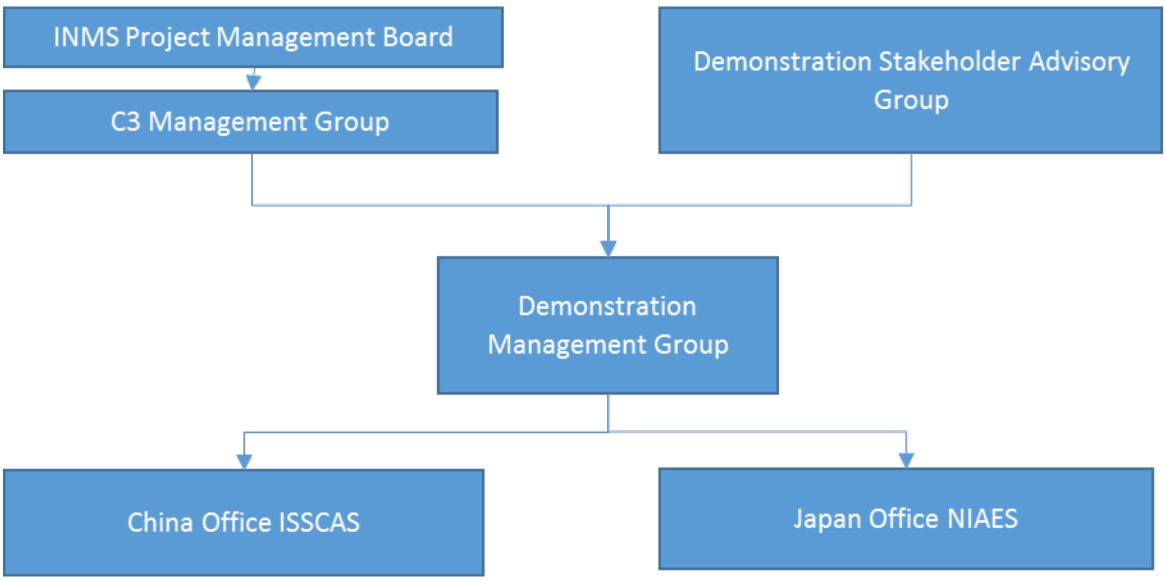
A 'Demonstration Management Group' (DMG) for East Asia will be established. This will be the main body for the implementation of the project's components. It will hold regular meetings, to review and approve Task Outputs and Interim Task Outputs and to provide regular reports to the Project

Management Board (PMB) and Project Co-ordination Unit. To better coordinate work of different countries, the DMG will consist two co-chairs, one in China and one in Japan. DMG current member scientists are mainly from China and Japan, each with backgrounds in a different discipline. The Institute of Soil Science, Chinese Academy of Sciences (ISSCAS) will play a leading role in DMG, by coordinating Chinese research activities, setting up the project office, hiring a postdoctoral researcher. Other Chinese members are mainly from China Agricultural University with expertise in agricultural nitrogen cycling, Zhejiang University, with expertise in industrial nitrogen flow, Institute of Applied Ecology, Chinese Academy of Sciences, with expertise in forestry nitrogen cycling.

The National Institute for Agroenvironmental Sciences of Japan (NIAES) will co-manage the regional demonstration activities. NIAES will also take a role as the node of Japanese activities connecting other Japanese institutes that directly join in the regional demonstration and other Japanese researchers by providing their research outcomes to the INMS and inviting them to relevant meetings as necessary.

A 'Demonstration Stakeholder Advisory Group' (SAG) will be established to oversee the work of the DMG, provide responses to consultation, review work of the Tasks, design and revise project work plan as required. Currently expected members of the SAG will be mainly from the China Nitrogen Workgroup (CNW) and the Japan Nitrogen Expert Group (JNEG). Both groups have been recently established. CNW consists of members from China Agricultural University, Nanjing Agricultural University, Chinese Academy of Agricultural Sciences, Nanjing Normal University, East China Normal University, Xiamen University, six research institutes of the Chinese Academy of Sciences, and fertilizer industry representatives. JNEG consists of members from the National Institute of Agroenvironmental Sciences, National Institute of Environmental Study, Hokkaido University amongst others. Wider membership of the SAG will also be encouraged during the project, including from other countries (such as Korea and the Philippines) and from business and civil society.

An outline of the proposed management structure is provided below.



Wider membership of the DMG SAG will also be encouraged during the project, including from other countries (such as Korea and the Philippines) and for the SAB –also from business and civil society.

Monitoring and evaluation of the project will be accomplished through reporting to the Component 3 Management Group and Project Management Board (in collaboration with the Project Co-ordination Unit) and also reviewed by the SAG. Performance indicators (see Section 4.1) have been outlined to measure inputs, activities, outputs, outcomes, and impacts of project activities. These and more detailed indicators will be used to set up performance targets and assess progress toward their achievement, and to flag the need for a follow-up review or evaluation of an activity.

4 Monitoring and Evaluation

4.1 Demonstration Project Results Framework

The present detailed log-frame (project results framework) covers aspects that are specific to the East Asia Regional Demonstration. It should be read in conjunction with the project results framework for Component 3 as a whole (see Appendix 17), which emphasizes common aspects between the different INMS demonstration regions.

	Objectively Verifiable Indicators			Sources of Verification	Assumptions
	Indicator	Baseline	Target		
Outcome 4: GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised	Project-level demonstration methodology guidelines adopted and published Requests for and application of demonstration area methodologies, tools and practice by external parties	Limited information from previous GEF interventions and partial N budget recently developed.	Project level methodology developed and agreed. Uptake of demonstration area methodology in other areas.	Workshop reports Contribution to synthesis documents	Active participation of the populations and policy makers in East Asia Availability of diversified expertise and technologies in East Asia

Output 3.1: A demonstration activity which delivers conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing: Case 1: Challenges and opportunities for developing areas with excess reactive nitrogen	Report on N sources and N flows for East Asia. Report on consensus on N priority sources, forms and impacts for East Asia. Regional condition according to agreed N performance indicators. Information on priority N management and mitigation options. Information on successes and opportunities. Information on regional specificities for global scenarios	Lack of joined up data on N sources and flows regionally. Lack of knowledge on how N sources and impacts fit together. Lack of knowledge on how different N indicators relate, especially at regional level. Diversity of views and lack of consensus on the best methods to obtain N co-benefits. Variable progress, with limited attention to linking N co-benefits Existing global scenarios paying insufficient attention to regional conditions.	Quantified N flows, with uncertainty indication by end Year 3. Clearly identified priorities for N sources, forms and impacts by end Year 3 Statement of East Asia performance in using agreed N indicators by end Year 3. Draft 'Top 10' priority measures for improved N management for East Asia (end Year 2). Document for East Asia, showing how N approach can address barriers and share success stories (Year 4). Global scenarios informed by evidence from East Asia Demonstration (Year 3).	Reports, contrib'n to global synthesis (A2.2). Reports of science-stakeholder workshops. Report and contribution to INMS publications. Report provided to A2.3 for incorporation in global comparison. Documents for East Asia demonstration. Report from A2.4 workshop.	

The following topics are also included: • Regional demonstration to increase Nr agronomic efficiency in East Asia	Field trials in regional demonstration activities show an improvement of 20% in Nitrogen Use Efficiency [SR]: Adoption of agricultural technologies to improve N_r agronomic efficiency	Low efficiency of N in East Asian agriculture	Field trials in demonstration region (Yr 4): Increase N_r agronomic efficiency at scale by 20% of the baseline level in test plots shown	Reports from C3 Management Group	Known co-financing at selected demonstrations will allow field trials. Field trials in other demonstration areas will be subject to the availability of additional co-financing.

4.2 Monitoring &Evaluation

Monitoring and evaluation of the project will be accomplished through reporting to the Component 3 Management Group and Project Management Board (in collaboration with the Project Co-ordination Unit) and also reviewed by the SAG. Performance indicators (see Section 4.1) have been outlined to measure inputs, activities, outputs, outcomes, and impacts of project activities. These and more detailed indicators will be used to set up performance targets and assess progress toward their achievement (see also Key Indicators below), and to flag the need for a follow-up review or evaluation of an activity.

The DMG is the main body for the implementation of the project's components. It will hold regular meetings, to review and approve Task Outputs and Interim Task Outputs and to provide regular reports to PMB.

Key indicators include:

- Realistic work plan to apply common methodology during project.
- Report on main flows and uncertainties suitable for submission as a scientific publication.
- Report on threat/benefit priorities relevant for communication with national and intergovernmental processes.

- Report on available options for mitigation/better N management, co-benefits' trade offs suitable for communication with national and intergovernmental processes.
- Three communication products delivered and disseminated to relevant stakeholders.
- Report on N load to East China Sea and available options for mitigation/better N management, co-benefits, trade offs.

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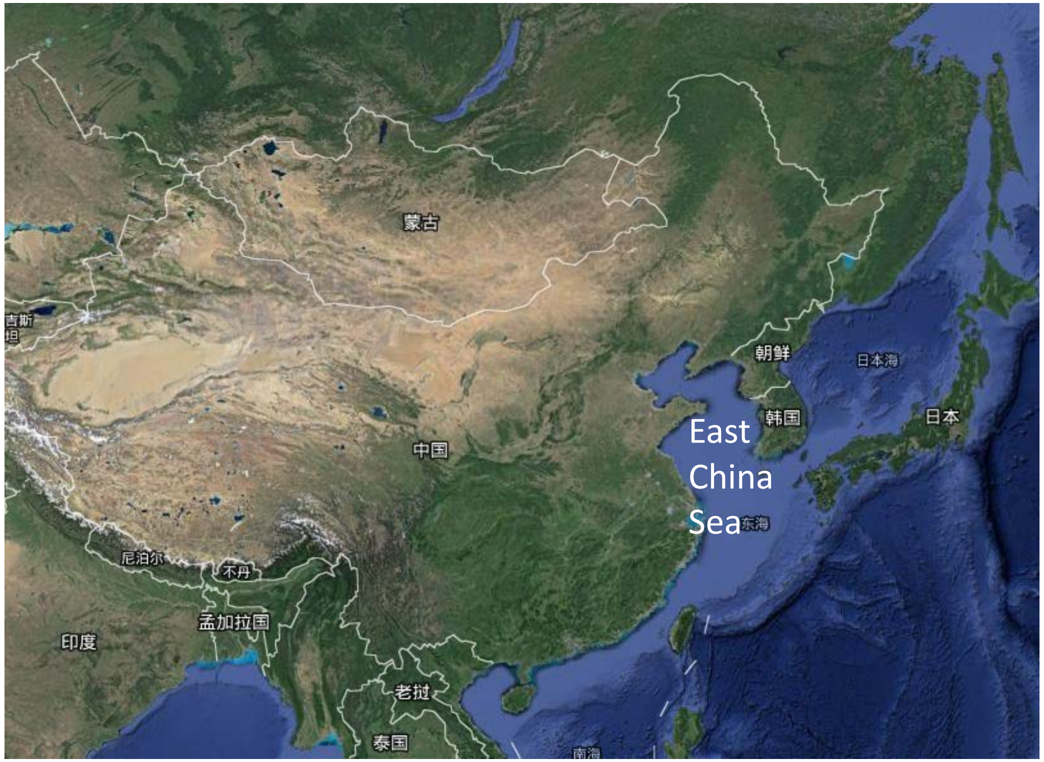
Zhang et al. (2012): Zhang W, Dou Z-X, He P, Ju X-T, Powlson D, Chadwick D, Norse D, Lu Y-L, Zhang Y, Wu L, Chen, X-P, Cassman K G, Zhang F-S. (2012) New technologies reduce greenhouse gas emissions from nitrogenous fertilizer in China PNAS | May 21, 2013 | vol. 110 | no. 21 | 8375–8380

Annex 1: Terms of Reference for Partners / Key Consultants

Terms of Reference for the roles of Demonstration Project Co-ordinators and Project Officers along with potential consultants, is included in Appendix 11. The remit of these roles, along with decisions on the institutions and persons taking on these roles for each Demonstration Region, will be subject to endorsement by the Project Partners Assembly at the Inception meeting of the project.

Annex 2: Details about Demonstration Region



INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 17b (Activity 3.1b)

SOUTH ASIA Demonstration

Summary

South Asia mainly comprises the sub-Himalayan countries: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka, located in the Southern part of Asia between the Himalayas on the North and the Indian Ocean on the south. Together, they cover an area of about 4.5 million km^2 (over 1.7 million mi^2), with less than 5% of the world's land mass, 14% of the global arable land, 2.73% of the world forest area and 4% of the world's coastline and yet support over 25% of the world's population and over 45% of Asia's population. The South Asian Association for Regional Cooperation (SAARC), which was established in 1985 includes all eight nations comprising South Asia. The South Asian Cooperative Environment Programme (SACEP), an intergovernmental environmental body of the SAARC countries provides a platform for coherent and coordinated interventions on a South Asian scale.

Both agriculture and industry contribute massively to the region's economy. Uneven development is common, both within and between countries of South Asia, partly due to the huge diversity of soil types, water availability, climate, socioeconomic and governance factors. This also implies contrasting situations in terms of N management. While the smaller, irrigated areas are characterized by intensive fertilizer usage, there is only a little applied in the larger, rainfed areas. There is further difference in N management between the peri-urban areas dominated by intensive livestock farming, and the rural areas where this type of agricultural management is less prevalent. Usable N is lost to ground water and surface water bodies through agricultural run offs, sewage, animal and human excreta, and also into the air due to emission of reactive N compounds from agricultural soils, livestock, sewage dumps, residue burning, vehicular and industrial emissions and industrial waste (e.g. Food/Beverage Manufacturing, Slaughter Houses, Textile, Paper and Pulp, Agro-Based etc.).

In the selected countries (India, Nepal, Bangladesh, Maldives and Sri Lanka) the main factors influencing the N flows are a) the strong N exchange over the thickly vegetated cropping regions; b) the huge amount of cattle excreta generated by the enormous cattle population; c) the high amount of municipal solid waste produced at the densely populated regions; and d) the strong agricultural activities, using organic and synthetic N fertilizers. In terms of N flows and cycling in the environment, these factors make these countries a coherent region.

The coastal habitats of South Asia are at a high risk of eutrophication due to the accumulation of reactive N, apart from other nutrients. There are pockets of coastal eutrophication around the Indian peninsula, and N-loading has been observed also in several lakes and other inland water bodies, in addition, high levels of nitrates has been reported in the ground water in some places. The lack of their systematic geographical or chronological documentation has hampered credible trend analyses and thus, prevented informed decision on sustainable N management.

The nitrogen transport by the rivers in South Asia was reviewed by Subramanian (2008). In this study the average NO_3-N in water was estimated at 2.1 mg l^{-1} of which the average sediment bound N, mostly organic, was 0.2% with significant contribution of PON (particulate organic nitrogen). The extent of nutrients load in Kurunegala Lake, Sri Lanka has been reported by Peiris and Miguntanna (2012). The lake has been seriously threatened by eutrophication. The research confirmed that nitrate accounts for more than 80% of the total nitrogen content, with an aqueous concentration of

1.401 ppm to 5.037 ppm. The major source of nitrate was identified as nitrate leaching from the surrounding fertilized rice fields.

The Indian Nitrogen Group (ING) was conceived in 2004 by the Society for Conservation for Nature (SANC) and formally launched in 2006 to bring interdisciplinary convergence of scientists, industry stakeholders and government representatives from scientific, environmental, agricultural and other related ministries. It highlighted the importance of reactive N management, the need for a better understanding of the reactive N scenario in India and to identify the ways for better N management.

The overall aim of the South Asian demonstration under INMS is to collect all the available information on reactive nitrogen to quantify the overall N budget for the region, mainly based on data from India, Bangladesh and Sri Lanka and other South Asian countries to the extent available. The work programme involves collation of data on reactive N usage and/or its leakages from various relevant sectors such as agriculture, industry, traffic and domestic sewage and their N-loading into the soil, air, inland water bodies and coastal systems. The data will be collected on national, state and even higher levels in order to broadly identify the most N-polluting sector(s) and region(s). The past, present and future trends will be identified from the available data, based on the changes in population, consumption, landuse, policies etc. The technologies and practices in widespread use, as well as the availability and penetration of more efficient technologies/practices and the experience with such interventions will be documented as case studies. Knowledge dissemination to stakeholders would result in better N use and management and better N end-usage.

The South Asian Regional Demonstration could cost at least 270,000 USD and may go upto 300,000 over the entire duration, to cover the costs of travel, staff, contingencies and institutional overheads.

Being the most populous and the fastest growing region of the world with a distinct socio-economic, cultural and climatic profile, a better quantification of the reactive N scenario in the South Asian region is very essential for a more accurate understanding of the global N-cycle as well as for the development of a realistic International N Management System. The South Asian region also offers a tropical testing ground for the validation of assumptions made on the basis of Western experience, and the adoption of more informed means of estimating the region's N-budget as well as its contribution to the global N-budget. The development/demonstration of local capacity for N-cycle assessment could catalyse better regional cooperation and future global engagement at the scientific and policy levels in reactive N management. INI has a regional South Asian Nitrogen centre in New Delhi, with strong scientific and industry partners throughout South Asia, as well as policy level interactions at the Indian government as well as with the intergovernmental South Asia Cooperative Environment Programme. Therefore, there are strong institutional and intellectual linkages among the implementing partners of INMS within South Asia, as well as between the South Asian and global leaders of INMS.

Contents

Abbreviations

BRRI: Bangladesh Rice Research Institute

CDA: Chilika Development Authority, Bhubaneswar, Orissa, India.

IARI: Indian Agricultural Research Institute

ING: Indian Nitrogen Group

KIIT: Kalinga Institute of Information Technology, Bhubaneswar, Orissa, India.

NEERI: National Environmental Engineering Research Institute (CSIR), Nagpur, India.

NPL: National Physical laboratory

NPL: National Physical Laboratory (CSIR), New Delhi, India

SACEP: South Asia Co-operative Environment Programme

SANC: South Asian Nitrogen Centre

SCON: Society for Conservation of Nature

1 Introduction to the SOUTH ASIA Demonstration in 'Towards INMS'

1.1 Background and Context

1.1.1 The regional problem

South Asia is one of the most populous and the fastest growing regions in the world, with its attendant environmental problems and nutrient cycles. It mainly comprises the sub-Himalayan countries: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka, located in the Southern part of Asia between the Himalayan Mountains on the North and the Indian Ocean on the south. Together, they cover an area of about 4.5 million km^2 (over 1.7 million mi^2), with less than 5% of the world's land mass, 14% of the global arable land, 2.73% of the world forest area and 4% of the world's coastline and yet support over 25% of the world's population or over 45% of Asia's population. To add to the pressure on the environment due to these reasons, the region has been suffering from uneven rainfall, floods, earthquakes, landslides, tsunami etc. On their side of the Indian peninsula, there are small islands like the Andamans on the east and Lakshadweep and Maldives on the west, which are ecologically fragile and vulnerable to the effects of climate change. The South Asia Co-operative Environment Programme (SACEP) was established in 1982 by the governments of South Asia to promote and support protection, management and enhancement of the environment in the region. The member countries SACEP are Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

South Asia has a diversity of ecosystems from lush tropical forest to harsh, dry desert, a huge diversity of languages, religions and outlooks across the sub-continent. Yet, their shared history and culture puts them apart from the rest of the world. Most of the South Asian nations share many similar environmental problems, stemming from poverty and its consequences on natural resources. According to the World Bank, during the past decade, South Asia has been the second fastest economically growing region in the world, and their efforts at increased production have put increasing pressure on natural resources and the environment. Significant natural resource concerns of the region include depletion of water quality and quantity, dwindling forests and coastal resources, and soil degradation resulting from nutrient depletion and salinization. A few highlights of the environmental problems of South Asia are:

The region has barely one twentieth of the earth's surface but has to support one fifth of the world population. Urbanization is accelerating in South Asia, with several fast growing cities like Mumbai, Calcutta, Delhi, Karachi and Dhaka having population of over 10 million. Despite primarily agricultural economies, industrialization has increased during the past decade. Over 30 percent of the population earns less than one dollar per day.

South Asia is home to 14% of the world's remaining mangrove forests; with Sundarbans between Bangladesh and India being one of the largest continuous mangrove stretch in the world. Six percent of the world's coral reefs are in the South Asian seas. The atolls of Maldives and Lakshadweep islands are rich in marine biodiversity. Hindu Kush Himalayan belt is home to over 25,000 major plant species, comprising 10 percent of the world's flora. The region is prone to natural disasters such as cyclones, floods and landslides.

Governments of the region have taken some domestic actions for the protection and management of the environment, as well as signed many multilateral agreements to work cooperatively towards environmental protection and sustainable development. One such example is the Malé Declaration on control and prevention of air pollution and its likely transboundary effects for South Asia. Another example is the SACEP scoping study on the nutrient loading and eutrophication of coastal waters of the south Asian seas, which was accepted by the environmental ministers of the region. Both encourage intergovernmental cooperation to combat pollution and nutrient loading in South Asia. Reactive nitrogen is a major component in both of them.

1.1.2 What are the issues of N (too much and too little)

Uneven development within and between countries of South Asia, as well as the huge diversity of soil types, water availability, climate, socioeconomic and governance factors contribute to the contrasting situations in terms of N management. For example, there is intensive use of chemical fertilizers in the few irrigated cropping areas of each of the South Asian countries, including flood-prone areas, contributing to run-off losses and volatilisation of reactive N. On the other hand, there is too little use in the vast rainfed areas of cropping, leading to soil mining of nutrients and soil degradation. Similarly, intensive livestock farming is common in peri-urban areas compared to its relatively thin spread in the rural areas with little or no regulation on N-losses in all the cases. Usable N is lost to ground water and surface water bodies through agricultural run offs, sewage, animal and human excreta, and also into the air due to emission of reactive N compounds from agricultural soils, livestock, sewage dumps, residue burning, vehicular and industrial emissions(e.g. Food/Beverage Manufacturing, Slaughter Houses, Textile, Paper and Pulp, Agro-Based etc.).

The coastal habitats of South Asia are at a high risk of eutrophication due to the accumulation of reactive N, apart from other nutrients. There are pockets of coastal eutrophication around the Indian peninsula, and N-loading has been observed also in several lakes and other inland water bodies, in addition high levels of nitrates has been reported in the ground water in some places. In the selected countries (India, Nepal, Bangladesh, Maldives and Sri Lanka) the main factors influencing the N flows are a) the strong N exchange over the thickly vegetated regions; b) the huge amount of cattle excreta generated by the enormous cattle population; c) the high amount of municipal solid waste produced at the densely populated regions; and d) the strong agricultural activities, using organic and synthetic N fertilizers. In terms of N flows and cycling in environment, these factors make these countries a coherent region.

1.1.3 Overview of the intervention and rationale

The intervention proposed in this project is the demonstration of an integrated assessment of the reactive N problem in South Asia, covering the trends at the national and state level. It includes all the major sectors such as agriculture, industry, traffic, solid waste and domestic sewage and their N-loading into the soil, air, inland water bodies and coastal systems. There has been a slow, but growing awareness regarding the loss of reactive nitrogen from production systems and its environmental consequences, partly due to the work of the Indian Nitrogen Group with various agencies of the Indian government and of the ING and the South Asian N Centre through SACEP. But the lack of their systematic geographical or chronological documentation and assessment has hampered credible trend analyses and thus, prevented informed decisions on sustainable N management. Therefore, the overall aim of the South Asian demonstration under INMS is to collect all the available information on reactive nitrogen to quantify the overall N budget for the region, mainly based on data from India, Bangladesh and Sri Lanka and other countries to the extent available. In preparation for the demonstration activity a workshop was held in New Delhi in February - 'Reactive Nitrogen Assessment in South Asia' (see Annex 3), where activities in India, Bangladesh, Pakistan, the Maldives and Nepal were represented. The outcomes of that workshop will help to widen the network of partners for this demonstration activity during project implementation, increasing regional data coverage and engagement.

Past, present and future trends will be identified from the available data, based on the changes in population, consumption, landuse, policies, scenarios of intervention etc. The intervention would be made by generating awareness, increasing management skill, improving sanitation, and increasing personal accountability in waste disposal. The technologies and practices in widespread use, as well as the availability and penetration of more efficient technologies/practices and the experience with such interventions in both the underuse and overuse areas need to be documented with case studies and best practices. One such case study involves Chilika lake, the recently restored lagoon on the East coast of India, which developed an ecosystem health report card under the previous GEF project on global nutrient foundations.

1.1.4 What the intervention will result in – both nationally and regionally

The proposed South Asian demonstration with the support of GEF through UNEP will catalyze national and regional interest and engagement at the level of government, industry, scientific and other stakeholders. Unfortunately, despite the growing awareness of the issues related to reactive N in India and in South Asia at the level of SACEP, the lack of specific investments are delaying national assessments as well as the development and implementation of sustainable N management systems at the national and local level. This makes it even more difficult to mobilize them to act on a South Asian scale. Therefore, international involvement and funding continue to be a major factor in catalysing national and regional investments and actions. In this regard, South Asian N assessment and demonstration of options for better N management will be a major boost for national and local advocacy, as well as for better regional and global engagement.

1.1.5 Contributions to the INMS understanding/process

A better quantification of the reactive N scenario in the South Asian region is very essential for a more accurate understanding of the global N-cycle, as well as for the development of a realistic International N Management System. Given that South Asia is the most populous and the fastest growing region of the world with a distinct socio-economic, cultural and climatic profile, this region also offers a tropical testing ground for the validation of assumptions made on the basis of Western experience. This could in turn enable the adoption of more informed means of estimating the region's N-budget as well as its contribution to the global N-budget.

1.1.6 Relevance to national and regional policies

The development/demonstration of local capacity for N-cycle assessment could catalyze better appreciation of the importance and urgency of addressing issues of reactive nitrogen at the national and regional level. This in turn would lead to advocacy for the identification of the relevant current policies and the changes needed to ensure better management of reactive nitrogen. For example, one could revisit the impact of India’s recent nutrient-based subsidy for fertilizers, or the lack of effluent/emission norms for dairy/livestock or municipal sectors, or the apparent trade-off between vehicular/industrial emissions of reactive N and C species etc.Similarly, Bangladesh may revisit the impact of aquaculture on rice farming and coastal water quality and nutrient run off. The appreciation of the linkages between research, policies and actions on the ground could contribute to better preparedness for informed decisions at the national and regional level. Naturally, they demand the engagement of the various stakeholders including the government, industry, scientific community and civil society, which has already begun in India through the efforts of the Indian Nitrogen Group and in South Asia through the efforts of the South Asian Nitrogen Centre. An example of the latter is the South Asian ministerial level acceptance of the scoping study report commissioned by SACEP titled “Nutrient loading and Eutrophication of coastal waters of the South Asian seas”, which deals mainly with nitrogen and phosphorus, among others. Therefore, the South Asian regional demonstration of the nitrogen budget could enable informed decisions both at the national and regional level, apart from fostering regional cooperation and more constructive global engagement in reactive N management at the scientific and policy levels.

1.1.7 Relevance to global / regional agreements and conventions

Several South Asian countries are parties to all 3 Rio Conventions (that are relevant to reactive nitrogen) and Manila declaration on the Global Partnership on Nutrient Management, and are also actively involved in the discussion of sustainable development goals (UNSDSN) at the global level. At the regional level, there are several agreements/programmes/ mechanisms such as the South Asian Seas Programme (SASP), South Asia Environment and Natural Resources Information centre (SENRIC), South Asia Coral Reef Task Force (SACRTF), South Asia Biodiversity Clearing House Mechanism and the Governing Council of the South Asia Co-operative Environment Programme (SACEP). SACEP held a Workshop for the Development of a Regional Marine and Coastal Biodiversity Strategy for the South Asian Seas Region, and the SACEP Governing Council has adopted resolutions on ‘Clean Fuels and Vehicles’ as well as on ‘South Asia’s Biodiversity Beyond 2010’.

1.2 Environmental threats, root causes and barrier analysis

South Asian governments have not yet fully appreciated the various sources of reactive N and their social and environmental effects. The main reason for this is they were never confronted with the relevant scientific evidence of the seriousness of the problem. Since such evidence was never collected or presented in an integrated manner, due to the lack of adequate government investments.

The priority for food production prevailed over productivity due to food security concerns, which favoured the input-heavy monocultures and intensive farming systems, and has led to the ignorance of the nitrogen leakage from fertilizer application as well as other unintended releases from dairy/livestock, fisheries, sewage, fossil fuel burning etc. The lack of government regulation on leakages of nitrogen in these sectors in most South Asian countries has meant that N-pollution is legal. Residue burning, whether of agricultural or other wastes, is another major source of greenhouse gases in South Asia that continues despite its banning in several states.

The carbon-centric nature of policy discourse even in climate change circles have meant that leakages of reactive nitrogen can be tackled later, inspite of the fact that nitrous oxide being 300 times more reactive than carbon dioxide as a greenhouse gas. The professional scientific communities have been too preoccupied with the government priorities as they depended almost entirely on government investments for their research.

Another challenge has been the lack of enabling structures/mechanisms for interdisciplinary research, which is critical to quantify the biogeochemical cycle for reactive N, considering that it cuts across many disciplinary boundaries. This was partly resolved in India with the formation of the Indian Nitrogen Group a decade ago and its regular efforts to network and engage the scientific, industrial and policy stakeholders. The formation of the South Asian N centre of INI in New Delhi and its involvement in the South Asian N workshop in New Delhi in 2010 and in the SACEP study in 2013, were good beginnings at the level of SAARC countries, but a lot more effort and investment is needed in this direction.

Even though the South Asian governments are now more receptive to discussing issues of reactive nitrogen, international investment and intergovernmental engagement can catalyze local priority setting and investments. The South Asian demonstration of INMS can therefore help in generating local capacities and datasets to aid more informed and more constructive regional and global engagement.

1.3 Institutional, sectoral and policy context

1.3.1 The main organisations (government and others) involved in N related issues

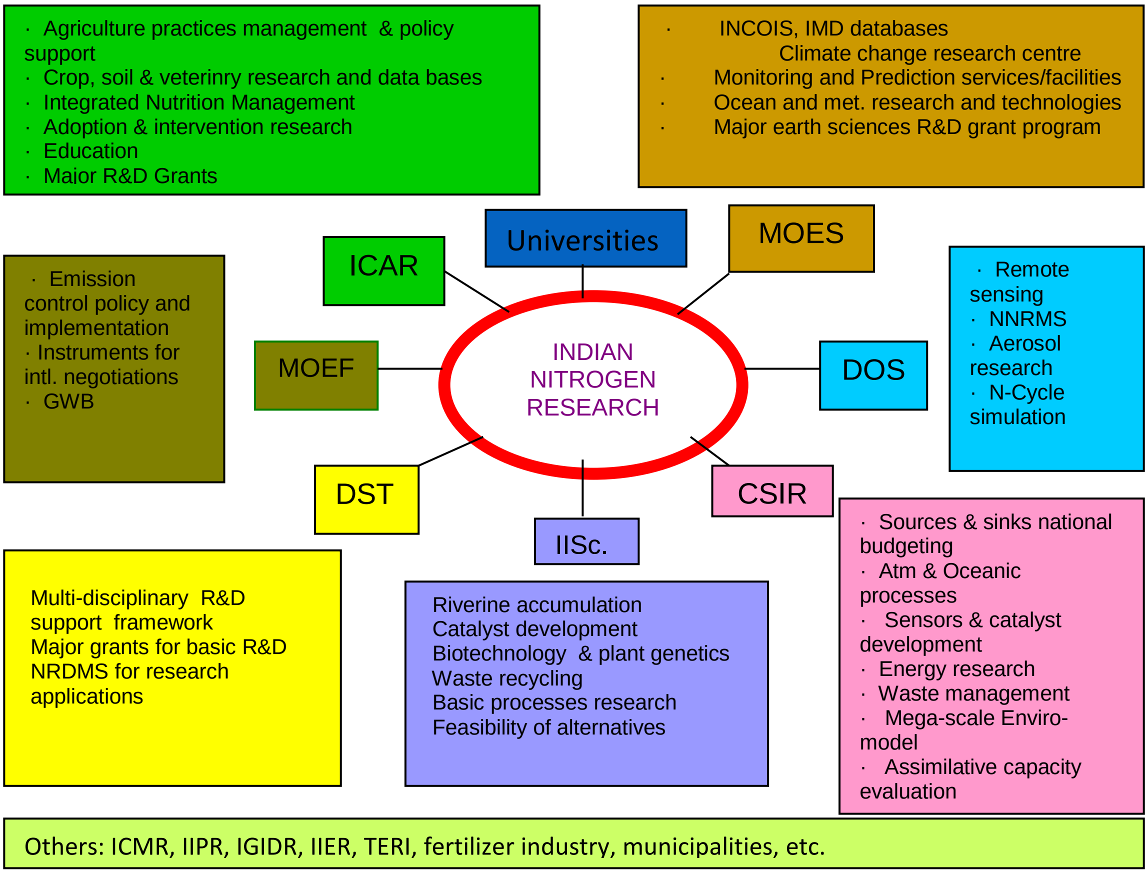
In most of South Asia, N-related research is spread over several agricultural institutions, environmental departments in universities and some national laboratories in the government sector. For example, in India, research related to N is covered under the programmes of several federal ministries such as agriculture, S&T, environment and forests, earth sciences, health, etc. They are carried out in several institutes under the Council of Scientific Industrial Research (CSIR), such as the National Physical Laboratory, National Institute of Oceanography, National Environment Engineering Research Institute etc., and agricultural institutes such as the Indian Agricultural Research Institute, Central Rice Research Institute, Punjab Agricultural University, Institutes of Fisheries, etc. There are other ministries such as the chemicals and fertilizers, industries etc., whose policies and actions impact N-management. The central and state-level pollution control boards are actively involved in monitoring the reactive N pollutants in water bodies and in air. The Chilika Lake Development authority is a state-level government body that monitors and regulates the nutrient-loading into Chilika Lake lagoon. The urban municipal bodies are generally elected and work with the district administrations, whereas the rural municipalities are directly under the government. These agencies are directly involved in dealing with sewage and solid waste management and are almost entirely isolated entities with little or no networking among them to enable data sharing at the state or national level. This is partly the reason for the lack of reliable statistics on the actual contribution of the municipal sector to the total reactive N loading in South Asia. However, the contribution of these agencies can be significant to the sustainable N management if they can introduce nutrient recovery/recycling prior to disposal, arrest residue burning etc.

Some Institutions in South Asia with expertise relevant to N-management:

AIIMS:	All India Institute of Medical Sciences
ARAI:	Automobile Research Association of India

BHU:	Banaras Hindu University
BRRI:	Bangladesh Rice Research Institute
CGWB:	Central Ground Water Board
CIMAP:	Central Institute of Medicinal and Aromatic Plants
CRRI	Central Road Research Institute
CRRI-ICAR:	Central Rice Research Institute
CSE:	Centre for Science and Environment
CSIR:	Council of Scientific and Industrial Research
CWRDM:	Centre for Water Research, Development and Management
DBT:	Department of Biotechnology
GGSIPUniv:	Guru Gobind Singh Indraprastha University
GWB:	Ground water Board
IARI:	Indian Agricultural Research Institute
ICAR:	Indian Council of Agricultural Research
ICMR:	Indian Council of Medical Research
IGP-RWC	Rice-Wheat Consortium
IIRS:	Indian Institute of Remote Sensing
IISc:	Indian Institute of Science
IITs:	Indian Institutes of Technology
ING	Indian Nitrogen Group
JNU:	Jawaharlal Nehru University
MOEF:	Ministry of Environment and Forests
NCAP	National Centre for Agricultural Policy
NCL:	National Chemical Laboratory
NEERI:	National Environmental Engineering Institute
NGRI:	National Geophysical Research Institute
NIH:	National Institute of Hydrology
NIO:	National Institute of Oceanography
NIOM:	National Institute of Ocean Management
NIPFP	National Institute for Public Finance and Policy
NISTADS:	National Institute of Science, Technology and Development Studies
NPL:	National Physical Laboratory
NRSA	National Remote Sensing Agency
PDCSR:	Project Directorate of Cropping Systems Research
PRL:	Physical Research Institute
SAUs:	State Agricultural Universities
SCON	Society for Conservation of Nature
TERI:	The Energy and Resources Institute

Indian institutions/agencies involved in aspects related to Nr



1.3.2 Main private sector organisations (industry, farmers, etc) and where N used/produced etc

In the private sector, the fertilizer manufacturing industries, livestock, poultry, fisheries, animal feed and agro-processing industries are engaged in activities relevant to N-management in the agricultural sector. Among them, only the Fertilizer Association of India produces annual statistics on the manufacture and sale of inorganic fertilizers in India. However, crop-wise break-up of fertilizer use is not available yet, barring a few estimates based on sample surveys. Farmers associations largely focus their attention on fertilizer access, subsidies, bank loans and loan-waivers, rather than N-use efficiency. Outside agriculture, the Automobile Research Association of India (ARAI) keeps track of information related to emission control efforts from car industries and some related statistics. Poultry manure, which is a good source of N and P, is already being recycled as fertilizer in states like Andhra and Karnataka of India, but its use could be spread further. In aquaculture, neem cake and karanja cake are used against predator fishes, but this also helps in controlling nitrification-denitrification and the consequent N-losses. The consumption of animal products is only among 4% of the Indian population, but it is growing and its contribution to inefficient nutrient use needs to be factored into the long-term nutrient management. India has a huge recycling industry, but it doesn't yet serve nutrient management or agriculture sector. An enabling policy framework that incentivizes nutrient recovery and recycling is needed for all countries of South Asia.

1.3.3 What national policies are in-place / planned

Some of the existing policies in several of the South Asian countries include the system for government-recommendations of fertilizer dosages for different crops and agro-climatic regions. In India, there is an elaborate system of dose-response evaluations for all major agricultural inputs before the official release of major crop varieties, but the yield-centric approach of this system has confused input-response with input-use-efficiency. The recent Indian policy of nutrient-based subsidy was brought to incentivize the development and adoption of use-efficient and balanced fertilizers, including chemical/bio/organic fertilizers. India also has a policy of setting up soil-testing labs and soil health cards for every district of India and many are already in place. Biomass burning is already banned in many states, but enforcement has been weak. While more policy inputs could help in the medium/long term, effective implementation of existing policies could bring significant gains in the short term (eg. site-specific/balanced/integrated nutrient management, banning biomass burning etc.).

In the automobile sector, the growth of private transport (especially diesel vehicles) is leading to the growing loss of N as NOx. In Delhi, it is reversing major gains made over the last decade through the CNG policy, improvement in public transport through metro trains and modernized buses. Other policy successes of India are in the nationwide implementation of Bharat stage I-IV emission norms (on the lines of Euro I-IV), phasing out 2-stroke engines, enabling new technologies like Selective Catalytic Reduction (SCR) to reduce NO_x emissions from diesel vehicles, electric vehicles, hybrid vehicles etc.

In the energy sector, the growing combustion of fossil fuels to meet the energy needs of a growing economy has led to increasing loss of N as NO_x from thermal power plants, although their relative contribution compared to other sectors is low,. Technologies like low NOx burners are being encouraged to limit NO_x emissions from such large point sources. Similarly, policy incentives and focused implementation has seen tremendous growth in the adoption of solar power in the last few years in India, including large installations and small scale roof-top solar power systems.

1.3.4 NGO and CSO activities

Until the establishment of the Indian Nitrogen Group (ING), the NGO and CSO sectors in India and much of South Asia have been less focussed on N-management.They dealt with broader issues of pollution in water/air/land or with sector-specific environmental issues such as power sector, transport sector etc.The recognition of N losses to the environment and their sustainable management varied between regions, sectors and levels of implementation. The ING has been able to bring together scientists, industry managers and policy experts all over India and highlight the importance of reactive N assessment and management as part of the research and policy agenda over the last decade. The ING brainstorming workshops and publications and the N2010 conference in New Delhi strengthened the co-operation between the stakeholders and the appreciation of the issue of N management. ING also set up the INI Regional Centre, the South Asian N centre in New Delhi, and held a few South-Asian workshops and put together the nutrient management report for SACEP. These efforts have prepared reasonable ground for government actions at the national and South Asian level, so that even small and concrete steps could generate considerable impetus.Two of the most important impacts of the ING advocacy in India has been the clear identification of N-use efficiency as a major agricultural research goal by the Indian government in its National Initiative (now Innovations) for climate-resilient agriculture (NICRA)and the Indian federal Department of

Biotechnology's call for Indo-UK proposals to set up joint virtual N centres around plant NUE, agronomic and environmental NUE and biological N fixation by 2016.

2 Baseline for the SOUTH ASIA Demonstration in 'Towards INMS'

2.1 Baseline analysis

2.1.1 Previous work that is relevant to the work of this project

The activities of the Indian N Group and the South Asian N centre in association with its partners from academia, industry and policy stakeholders have led to the development of sustainable N management as an important agenda for research and policy. Around this agenda, several individual and institutional partners have been identified in India and South Asia, who have contributed to the N-special issue of the journal Current Science in 2008, ING bulletins on reactive N in various sectors before and after the N2010 conference in New Delhi, the organization of the CBD COP-11 side event at Hyderabad in 2012, the Our Nutrient World report for UNEP-GPNM, and the SACEP report on nutrient management in South Asia. Among others, district-wise N and P use data was mapped for all the 500-odd districts of India. Our partners have conducted the feasibility analysis of compiling the information on N management in cropping, animal husbandry, poultry, fisheries, sewage/solid waste and the resulting N loss into water and air pollution from all over India and elsewhere in South Asia in preparation for the regional demonstration under the INMS.

2.1.2 Relevant activities undertaken to 'manage' N

The Indian Nitrogen Group has generated awareness among scientific, industry and policy circles for better N management through above activities and publications. ING also developed proposals for detailed Indian national N assessment and submitted them for funding to the Government of India over a year ago. The Indian map of district-wise inorganic N fertilizer usage data was used to identify the districts that have the highest and lowest N usage to address issues of too high and too low N usage that contribute to unsustainable N management. Efforts are underway by our partners to compile the current and emerging technologies, products and practices for N-use efficiency. This has already been completed for cropping in India, but is being extended to other sectors and other countries of South Asia.

2.1.3 GEF actions

Our partners from the first GEF-funded GPNM project at Chilika lake in Odisha, India, have developed an ecosystem health report card for Chilika, which includes the monitoring and management of reactive N in the lagoon. A more detailed case study of Chilika lake as a model for other ecosystems is envisaged as a part of this project.

2.1.4 Other Donors and National funding

There are no other direct cash donors for this South Asian demonstration (other than GEF), but significant in-kind inputs have gone into the preparatory work done by many of our partners using their institutional facilities and salaries, not only in India but much of South Asia. In addition, this INMS South Asian regional demonstration builds on some previous workshops/events/activities sponsored in cash by Indian government agencies such as the Council of Scientific Industrial Research, Union Ministries of Science and Technology, Environment and Forests, Earth Sciences, as well as regional agencies such as SACEP. The first South Asian N workshop was held by the Indian N group in New Delhi in mid-2010 with a small grant from UNEP. The 5th International N Conference held in New Delhi in 2010 was supported not only by the above-mentioned national and international agencies, but also FAO, International Fertilizer Association, Bill and Melinda Gates Foundation etc., which was a major rallying point for agenda setting on reactive N in India and South Asia, as well as for networking of partners.

2.1.5 Planned work that will contribute to the baseline/CF

In India, a quantitative compilation of all sources of reactive N losses from crops and fossil fuel burning in India has been an ongoing process for the Indian N Group, with the help of well-established partners. In less quantified areas like livestock, poultry, fisheries, sewage, solid waste, industrial effluents etc., identification of partners has been an ongoing process, so as to aid in quantitative compilation. The Indian N Group has been making similar efforts to obtain information from other countries of the South Asian region.

2.2 Gaps

2.2.1 What are main gaps in the region with respect to:

2.2.1.1 N policies

Other than fertilizer N-dosage recommendations and limits for reactive N pollution in potable water and air, there are very few other N-specific policies in South Asia. Nevertheless, policies meant to improve soil health and agricultural productivity including aspects of N-management, such as the Indian government's nutrient-based fertilizer subsidy, soil health labs and soil-health cards etc. There are also policies such as banning of burning agricultural and municipal residues, dung-cakes, etc., but their enforcement has been poor. There are also gaps that stand in the way of realizing the benefits of existing policies, such as the lack of emission/effluent standards of reactive N for specific sectors and point sources such as cropping, livestock, poultry, aquaculture, sewage, solid waste etc., as well as for specific ecosystems and specific ecosystem services (potable waters or recreational waters etc). Enabling policies and incentives are also needed for recovery/recycling reactive N and other nutrients from intensive animal husbandry, poultry, aquaculture, sewage, solid waste etc.

2.2.1.2 N practices

The gaps between policies and practices are the most obvious in the farmers' habitual tendency to exceed the recommended doses of N-fertilizers in irrigated crops, all of which may not be only due to the low cost and government subsidy. Another area is the habitual residue burning by farmers, municipal workers despite ban in many places. The widespread use of dung-cakes, firewood and other inefficient fuels may partly be due to the lack of affordable access to better fuels as well as the lack of better monetary or use value for dung (especially if cattle owners are not growing their own crops). But this is also due to the lack of a well-developed recycling industry that could offer products and services for recycling human and animal wastes as manures to offset inorganic fertilizers demand-supply balance in input management. The adoption of N-use efficient fertilizer formulations such as neem-coated urea, and practices such as deep placement, leaf colour charts, integrated nutrient management practices for better demand-supply of N in agriculture are growing slowly, especially in India, Bangladesh and to some extent elsewhere in South Asia.

2.2.1.3 Scientific understanding

A sustainable N-management system has to be built on a strong local scientific capacity for regularly monitoring and integratively analyzing the various aspects of the N-cycle, and a credible governance or management system that takes informed decisions and monitors their implementation. Currently, the N-related activities of the government, academia, industry and civil society are generally still very scattered in South Asia, due to the lack of adequate investments in developing integrated scientific understanding of the N cycle at the national or regional level. Fortunately, significant scientific capacities already exist in the countries such as India, Bangladesh and Sri Lanka in South Asia. The activities of the Indian Nitrogen Group and the INI in South Asia have already generated sufficient interdisciplinary interest among the scientific and industry stakeholders to co-operate with each other. But as several funding proposals remain pending with the government for over 2 years, development of an integrated and quantitative scientific understanding of the reactive N cycle could not take off in India or elsewhere in South Asia. This has also led to the inability to take informed decisions on the measures to identify and tackle the too-much and too-little N use areas/sectors for sustainable N management.

2.2.1.4 Funding for these

Despite the growing recognition of the importance of reactive N in air and water quality and climate change, government funding for the quantification and the management of the problems of reactive N is absent in much of South Asia. Due to the lack of interministerial coordination, the N-management aspects remain poorly addressed in many of the major national agricultural or environmental projects. For example, analysis of nutrients in general and reactive N species in particular could have easily been integrated into massively funded national projects on major rivers such as the Ganga, Yamuna, or the Clean India campaign, or rural sanitation schemes, energy missions etc. The South Asian regional demonstration under INMS could generate such interest and catalyze domestic actions to develop further synergies.

2.3 Stakeholder analysis

2.3.1 Who are the main producers/users of N

The main deliberate producers of reactive N are the fertilizer industries but there are many others who produce reactive N as an unintended by-product of their activities: livestock, poultry, aquaculture, food-processing industries, domestic sewage and industrial effluents, municipal solid and liquid waste, residue burning, dung-cake-fuel makers, fossil fuel using industries including energy and automotive makers. All these sectors are very well developed and are growing continuously in South Asia, but their relative contributions are to be quantified for targeted action

The Fertilizers Association of India and the Automotive Research Association of India have been our active partners in the discussions on the research, technology and policy aspects of sustainable N management in India. Farmers are the main users of reactive N species for food production. Most of the farmers in South Asia are unorganized, illiterate or poorly educated small or marginal farmers, holding farms below 2 hectares in size and speaking over a hundred languages and many more dialects. Wherever they exist, the priorities of farmers' organizations have been mainly around loans and access to affordable inputs, rather than nutrient use efficiencies, but they do remain very important in this regard.

2.3.2 Who are the main stakeholders

Scientists working on plants/crops, agriculture, soils, microorganisms, biogeochemistry, water pollution, air pollution, atmospheric science, modelling, fertilizer industries including makers of inorganic and organic fertilizers, farmers' organisations from crops, livestock, poultry and aquaculture, energy and car industries, municipalities, sewage and solid waste handling entities, people managing fragile ecosystems (eg: Chilika Lake, major rivers, beaches) and hospitality or other industries around them, NGOs, commercial manure suppliers, plantation owners etc. as well as policy makers/experts/managers from the government. The Indian Nitrogen Group has identified experts representing various stakeholder groups in order to obtain data from all available sources.

2.3.3 Role of the government in N management

The governments of South Asia can do a lot by acknowledging the problems of managing reactive N in their governance programmes and incorporating them in their priorities for research and policy, making timely investments, taking informed decisions, monitoring implementation throughout the command chain. For example, the governments can fund national N assessments to galvanize and institutionalise domestic researchers, identify priority sectors and areas for action, close the gaps in policies by announcing sector-specific N-emission/effluent standards for cropping, livestock, poultry, aquaculture, sewage, solid waste etc., as well as for specific ecosystems and specific ecosystem services (potable waters or recreational waters etc). Enabling policies and incentives are also needed for recovery/recycling reactive N and other nutrients from intensive animal husbandry, poultry, aquaculture, sewage, solid waste etc.

2.3.4 Role of the private sector (including farmers)

The fertilizer firms, seed companies and other related agri-businesses in the private sector can make and provide N-use-efficient fertilizers, cultivars, and provide training to farmers in the best practices for N-use efficiency on a farm. In India, the fertilizer companies such as Tata Chemicals, Nagarjuna Fertilizers, Coromandel Fertilizers and the Fertilizer Association of India have been our partners for over a decade in the discussions on the research, technology and policy aspects of fertilizer N use efficiency. The agro-processing industries can adopt technologies and practices that minimize wastage and conserve N and other nutrients throughout the food chain. Farmers are very important private entrepreneurs and stakeholders in voluntarily adopting the best products and practices for N-use-efficient farming. The private sector can also develop affordable technologies, products and services for recovery and recycling of nutrients from all available sources.

2.3.5 Role of the NGOs/Civil Society Organisations

There are separate NGOs dealing with farmers, environmental issues and health/sanitation issues, and all of them could potentially play a role in addressing their side of the nitrogen cycle. However, in the absence of any such NGO taking interest in issues of reactive N in South Asia, in this regard almost all the work has been carried out so far by the Indian N Group (Society for Conservation of Nature) and South Asian N Centre (SANC). Due to the highly scattered nature of expertise as well as published literature in this area, most of the effort of ING-SCON and SANC went into the establishment of a network of the available experts, the organization of workshops and the writing of specialized publications (see below) in order to put together the available information from several sectors and identify gaps in the available knowledge, current policies and practices. These efforts helped the experts identify and prepare the ground for a more comprehensive and integrative assessment of the state of reactive N in India and South Asia.

3 Project Description for the SOUTH ASIA Demonstration in INMS

3.1 Strategy

3.1.1 General information

The demonstration of a comprehensive and quantitative assessment of reactive N scenario in South Asia is consistent with the growing interest among the relevant government, scientific, industrial and other stakeholders in India and South Asia. The background has been already developed by the Indian N Group and South Asian N Centre at the national level and at the South Asian level through SACEP, and this demonstration would further catalyze the agenda/priority setting and promote investments at the national and South Asian levels in reactive N management. Such national and regional investments would be necessary for more detailed assessments for informed decisions and regular monitoring of the benefits accrued from various interventions.

3.1.2 Partners

The South Asian Demonstration will be led by N. Raghuram and YP Abrol from the Society for Conservation of Nature (SCON), a registered NGO competent to receive grants and submit accounts, and the umbrella organization that runs the Indian Nitrogen Group and the South Asian N Centre. SCON has earlier received grants from UNEP for South Asian N workshop and N2010. An initial list of partners is as follows, and it is anticipated that the links which were strengthened during the recent 'Reactive Nitrogen Assessment in South Asia' workshop (see Annex 3) will lead to further partners in the work (in countries such as Pakistan, Sri Lanka, the Maldives and Nepal):

Centre for Environmental Sustainability and Climate Resilient Agriculture, IARI, New Delhi [Key contact: Dr. Himanshu Pathak]

- National Environment Engineering Research Institute, Nagpur [Key contact: Dr. Vaidya]
- KIIT University, Bhubaneswar, India [Key contacts: Dr. Tapan Adhya and Dr. Mrityunjay Suar]
- Chilika Development Authority, Bhubaneswar India [Key contact: Dr. Ajit Pattnaik]
- National Dairy Research Institute, Karnal, India [Key contact: Dr. Madhu Mohini]
- Central Avian Research Institute, Izzatnagar, India [Key contact: Dr. A.B. Mandal]
- Central Inland Fisheries Institute, India [Key contact: Dr. Kuldeep Vass]
- Institute for Ocean Management, Chennai [Key contacts; Dr. Ramesh Ramachandran]
- National Physical Laboratory, New Delhi [Key contact: Dr. Chemendra Sharma]
- Bangladesh Rice Research Institute (BRRI), Bangladesh [Key contact: Dr. Jiban K Biswas

Project Objective: To improve the understanding of the global/regional(South Asian) N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems

Outcome 3.1: GPA, OECD, UNEA and other bodies are better informed to assist South Asian states with implementing management response strategies to address negative effects of excess or insufficient Nr, ensuring that any negative effects are minimised [This outcome is addressed through Component 3 of the project]

Output 3.1: A demonstration activity which delivers conclusions refining approaches to national / South Asian regional assessments and improving understanding of regional N cycle by addressing: Challenges and opportunities for developing areas/sectors with excess reactive nitrogen.

- **Activity 3.1:** Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.
- **Task 3.1.1 & 3.1.2:** Examination of N flows by source sector & loss pathway; including improving access to data across South Asia
- **Task 3.1.3:** Identifying & quantifying major uncertainties and means to improve

- **Task 3.1.4 & 3.1.5:** Identifying & agreeing key threat/benefit priorities with policy stakeholders in South Asia
- **Task 3.1.6:** Description of the South Asian scenario in relation to N performance indicators, in co-operation with global analysis
- **Task 3.1.7:** Review of available options among South Asian states for mitigation/better N management, co-benefits/trade-offs
- **Task 3.1.8:** Profiling success stories, barriers to change, and demonstration of N joined up approach in South Asia

3.1.3 Contribution to the overall INMS project

A better quantification of the reactive N scenario in the South Asian region is very essential for a more accurate understanding of the global N-cycle, as well as for the development of a realistic International N Management System. Given that South Asia is the most populous and the fastest growing region of the world with a distinct socio-economic, cultural and climatic profile, this region also offers a tropical testing ground for the validation of assumptions made on the basis of Western experience. This could in turn enable the adoption of more informed means of estimating the region's N-budget as well as its contribution to the global N-budget.

3.1.4 Linkages with GEF and non-GEF interventions

The South Asian Demonstration includes a case study on Chilika lake, which was a project site under the GEF/UNEP Global Nutrient Cycles (GNC) project, overseen by the Global Partnership on Nutrient Management (GPNM). During the GNC project, an ecosystem health report card was developed for Chilika lake, based on the measurement and management of nutrients including N. In the present project, the reactive N management in Chilika Lake would be explored in depth as a case study. In-kind contributions to the South Asian demonstration, will include expertise and facilities from a whole range of experts spanning all sectors/aspects of the N cycle from the major countries of South Asia.

3.2 Project Sub-components and activities

The South Asian demonstration area under INMS fits within case 1 of the 4 regional demonstration types, as it deals with developing countries with excess reactive N. The Indian N Group and the South Asian N Centre have already been engaged with several individuals and institutions in academia, industry, government, and civil society. The main partners have been identified who will contribute data from various sectors such as crops, livestock, poultry, fisheries, sewage/solid waste, surface water, ground water, coastal/marine systems and air pollution from combustion-dependent sectors in India. These partners shall review the literature and identify the sources of their data and the gaps in it, as their interim outputs, not only in India but also other countries of South Asia. Thus, all the sectoral partners shall contribute to all the tasks from their respective sectors. Variations in the breadth and depth of data are inevitable between countries/regions/sectors and will be dealt with as per commonly agreed methodology. Some of our partners, such as Himanshu Pathak, Chemendra Sharma and Tapan Adhya have the expertise for inter-sectoral integration and modelling, and the demonstration activities can also benefit from the international expertise that will be available from other components of the INMS project. The activities in the demonstration area will mostly be conducted under Activity 3.1, through several tasks and sub tasks – each with respective outputs (see Figures A17b1 – 4). The outcome will also feed in to inform developments in Component 2 in, A2.2 – global consolidated assessment & A2.3 - methods for better N management.

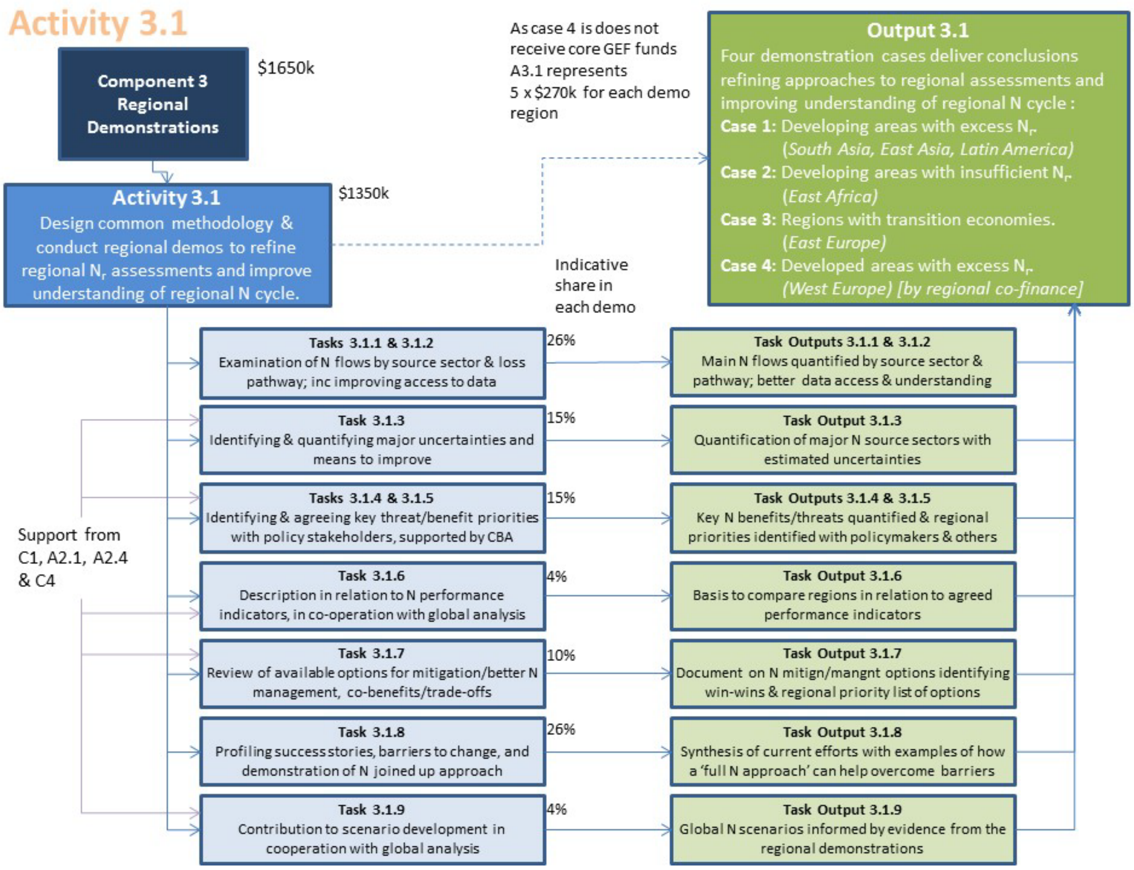


Figure A17b1: Structure of Activity 3.1, at Task and Task Output level.

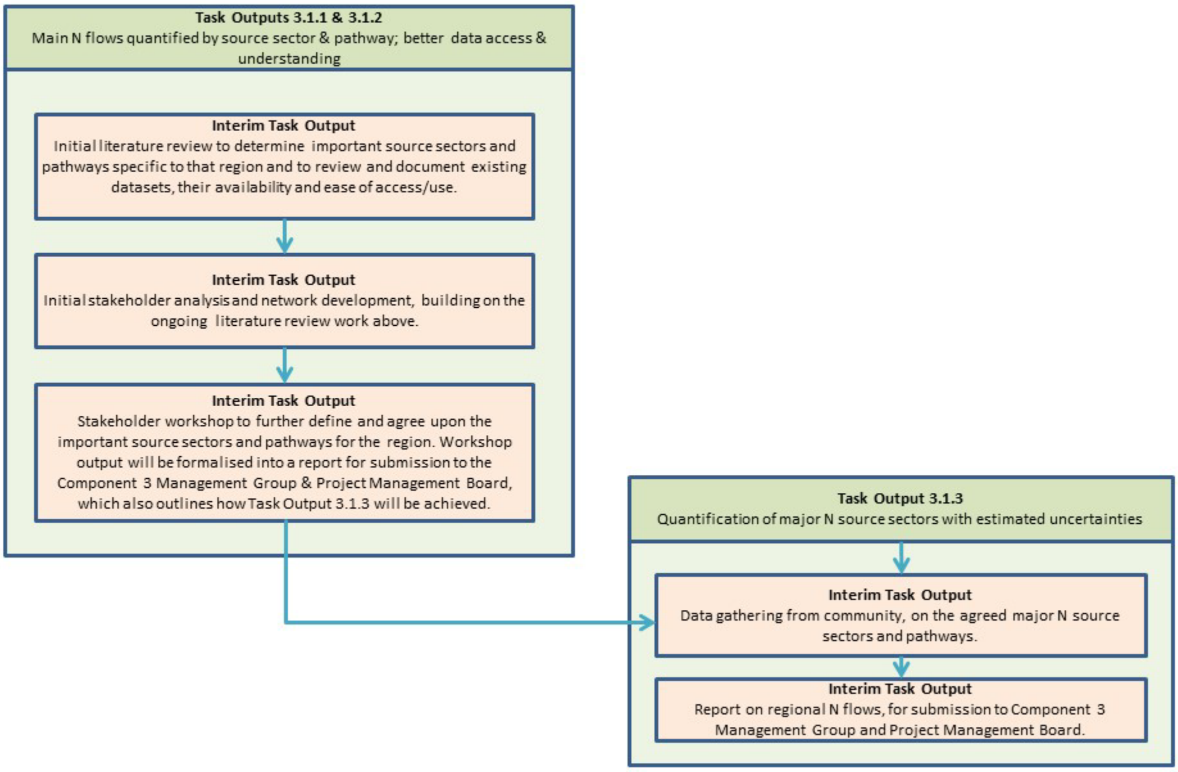


Figure A17b2: Interim Task Outputs for Task Outputs 3.1.1, 3.1.2 & 3.13 and how they are linked.

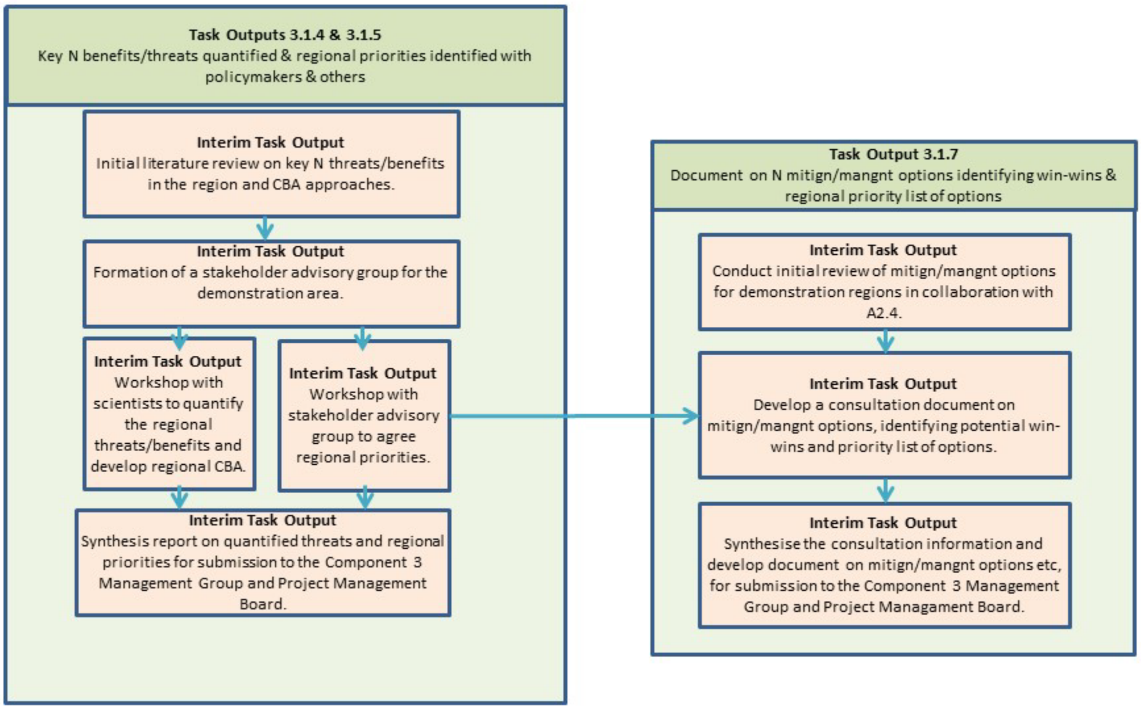


Figure A17b3: Interim Task Outputs for Task Outputs 3.1.4, 3.1.5 & 3.1.7 and how they are linked.

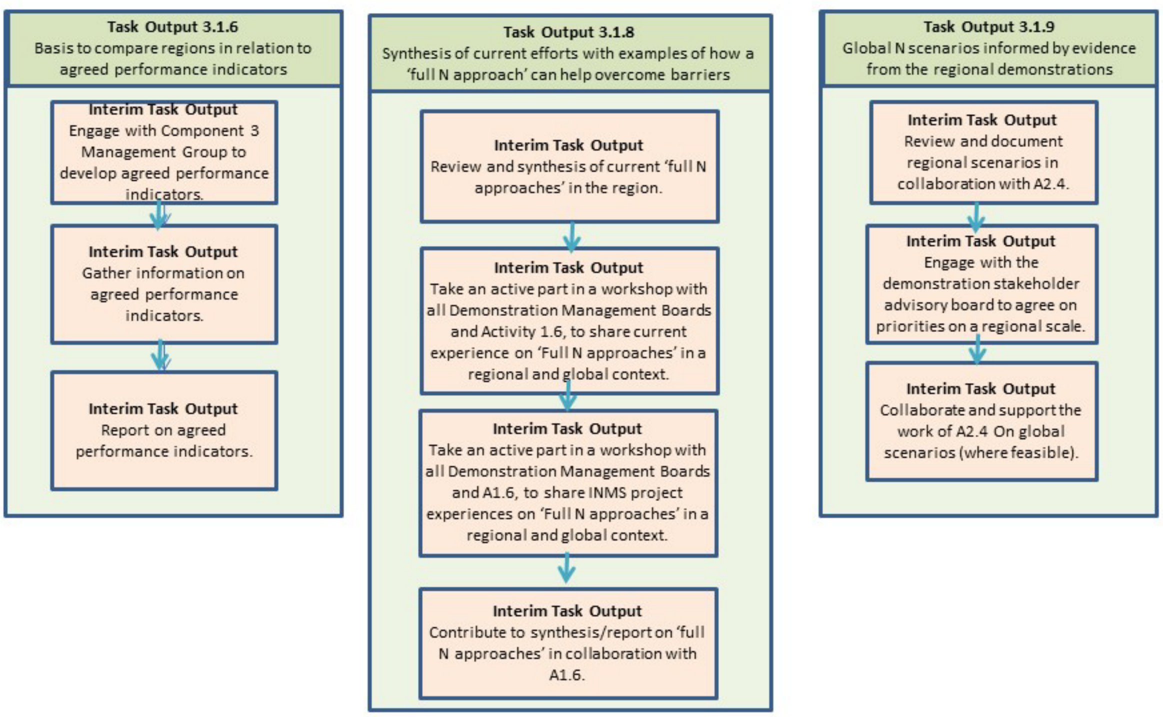


Figure A17b4: Interim Task Outputs for Task Outputs 3.1.6, 3.18 & 3.1.9 and how they are linked.

3.3 Budget and co-financing

The overall budget for South Asian demonstration is based on 40% for staff and admin costs, 40% for travel/meetings and 20% for outsourcing of any information/expertise and miscellaneous costs.

3.3.1 Budget

The prime requirements are a) establishing a regional coordination team (regional coordinator, and project officer(s) of pre/post-doctoral level and other office support, b) significant travel budget to allow meetings and team working, c) a smaller budget for necessary bought in services, d) engagement with leading scientists from other world regions to support sharing of expertise and tools. In order to maximize the support to the demonstration regions, it is proposed to cover d) under other components of the project.

With this approach, it is proposed that the South Asian regional demonstration would be indicatively supported by GEF funding as follows: a) 40% to support post-doc salaries (108,000 USD), b) 40% to support travel and meetings including preparing communications, reports and experiences (108,000 USD), c) 20% for additional bought-in services as necessary (e.g. to supplement key datasets, additional necessary information etc) (54,000 USD). It is proposed that the Society for Conservation of Nature acts as the Regional Agency (RA) for the South Asian Region and would be responsible for managing and distributing the GEF funds within the regional demonstration partnership according to terms of the contractual agreement with the overall Executive Agency (EA) of the INMS project. This provides a basic model that may be tuned according to the specific needs of each region.

Table A17b2: Budget breakdown by cost type

Cost Type	Cost per year (USD)	Cost for project [4 years] (USD)	Notes
Establishing and supporting a regional team			
Regional Co-ordinator			
Project Officer 1 (Two post-grad or 1 post-doc)	10,000	40,000	
Project Officer 2 (Two post-grad or 1 post-doc)	10,000	40,000	
Office and admin costs (including printing budget for dissemination materials, overheads)	7,000	28,000	
Total	***27,000***	***108,000***	
Support for meetings (including travel and venue budgets, preparing communications, reports and experiences)			
Travel & Subsistence Costs	10,000	40,000	
Venue and Catering Costs	10,000	40,000	
Preparing reports etc.	7,000	28,000	
Total	***27,000***	***108,000***	
Additional bought in Services (e.g. to supplement key datasets, honorarium for experts, overheads etc)			
Total	***13,500****	***54,000****	
Total for Demonstration	**67,500**	**270,000**	

Table A17b2: Budget breakdown by Task

Task	Cost (USD)	Notes
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	100,200	Most of the effort in South Asia will go into this compilation for the 1st time
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	40,500	This involves comparative analysis between sources/sectors
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders	40,500	This involves wider consultations between scientific, policy and other stakeholders
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	10,800	This involves integration of local and global analyses of indicators and performance
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	27,000	This requires wider consultations between scientists, industry and policy stakeholders
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	40,200	This includes case studies on Chilika, Delhi, and other sites (agri, non-agri)
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	10,800	This requires integration of local and global analyses
Total	**270,000**	

3.3.2 Co-financing

The indicative co-financing contributions shall be in the order of 1,150,000 US$, as follows:

Around 800,000 US$ worth of co-financed scientific and other partner contributions, involving about 400 man-months @ about 2000$ per man-month on average (actual time spent may vary from 10-40% of the entire project duration for each of the individual partners involved)

About 300,000US$ worth of office/lab infrastructure including space, furniture, computers, lab equipment, field equipment, subscribed journals, databases, etc.

Table A17b3: Co-financing budget, listed by Task and Partner

Task	Co-financing (USD)	Partner	Notes (including information on the project, links to the tasks, project duration etc.)
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	400,000	**SCON in association with IARI, NEERI, NPL, KIIT, CDA, NDRI, other**	Task duration can be seen in Section 3.4 'Workplan'.
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	150,000	**SCON in association with, IARI, NEERI, NPL, KIIT, CDA, NDRI**	
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	150,000	**SCON in association with, NEERI, IARI, NPL, KIIT, CDA, NDRI**	
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	50,000	**SCON in association with, NEERI, IARI, NPL, KIIT, CDA, NDRI**	
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	150,000	**IARI in association with, SCON, NEERI, NPL, KIIT, CDA, NDRI SCON, IARI, GGSIPU**	
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	200,000	**KIIT, CDA, GGSIPU,NEERI, SCON**	
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	50,000	**SCON in association with IARI, NEERI, NPL, KIIT, CDA, NDRI, other**	
TOTAL	**1,150,000**		

3.4 Work Plan

The table below indicates the relevant Tasks and the planned timescales for the work. At the start of the project this work plan will be reviewed, in collaboration with the work plans for the other demonstration regions and the overall Actvity 3.1 and Activities 3.2-3.4 work plans. This is to ensure that items from all demonstration areas will be delivered in time for necessary inputs to other activities and comparative studies across component 3.

	Year 1				Year 2				Year 3				Year 4			
Task	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 1**	**Q 2**	**Q 3**	**Q 4**	**Q 1**	**Q 2**	**Q 3**	**Q 4**
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data																
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve																
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA																
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis																
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs																
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach																
Task 3.1.9: Contribution to scenario development in cooperation with global analysis																

3.5 Sustainability

The Indian Nitrogen Group and South Asian N Centre are already active in India in the last decade and have already generated sufficient interdisciplinary interest among scientific and industry stakeholders to co-operate with each other. Several individuals and institutions in academia, industry, government, and civil society are engaged in this. We have identified new partners who contribute data from various sectors such as crops, livestock, poultry, fisheries, sewage/solid waste, surface water, ground water, coastal/marine systems and air pollution from combustion-dependent sectors in India. These old and new partners shall identify the gaps not only in India but also other countries of South Asia and will contribute in their respective sectors even after the project is over. For example, analysis of nutrients in general and reactive N species in particular could easily be integrated into massively funded national projects on major rivers such as the Ganga, Yamuna, or the Clean India campaign, or rural sanitation schemes, energy missions etc. The South Asian regional demonstration under INMS could generate such interest and catalyze domestic actions to develop further synergies.

3.6 Replication

Given that South Asia is the most populous and the fastest growing region of the world with a distinct socio-economic, cultural and climatic profile, this region offers itself as a suitable model for validation of assumptions on better quantification of reactive N. This could in turn enable the adoption of more informed means of estimating the region's N-budget as well as its contribution to the global N-budget. As already noted above, first steps for replication could include targeting major rivers such as the Ganga and of course other countries in the South Asia area, where gaps have been identified during the work of the Towards INMS project.

3.7 Awareness raising, communications and dissemination

National/ Regional workshops or meetings/discussions with various stakeholders would be held every year to exchange ideas and disseminate the findings of demonstration activities. Ideally, they will be held at different places involving relevant government/industrial/civil society stakeholders and their institutions where possible. The feedbacks received in workshops/ meeting could be used for refinement of subsequent demonstrations and disseminations. Agricultural N management and sewage/solid waste management will be given special emphasis, as they are expected to be the main sources of N_r leakages. Links will also be made with the activities of Component 4 of the project to maximise synergies with this work – e.g. region specific products, ensuring items developed in Component 4 are fit for purpose in the South Asia region.

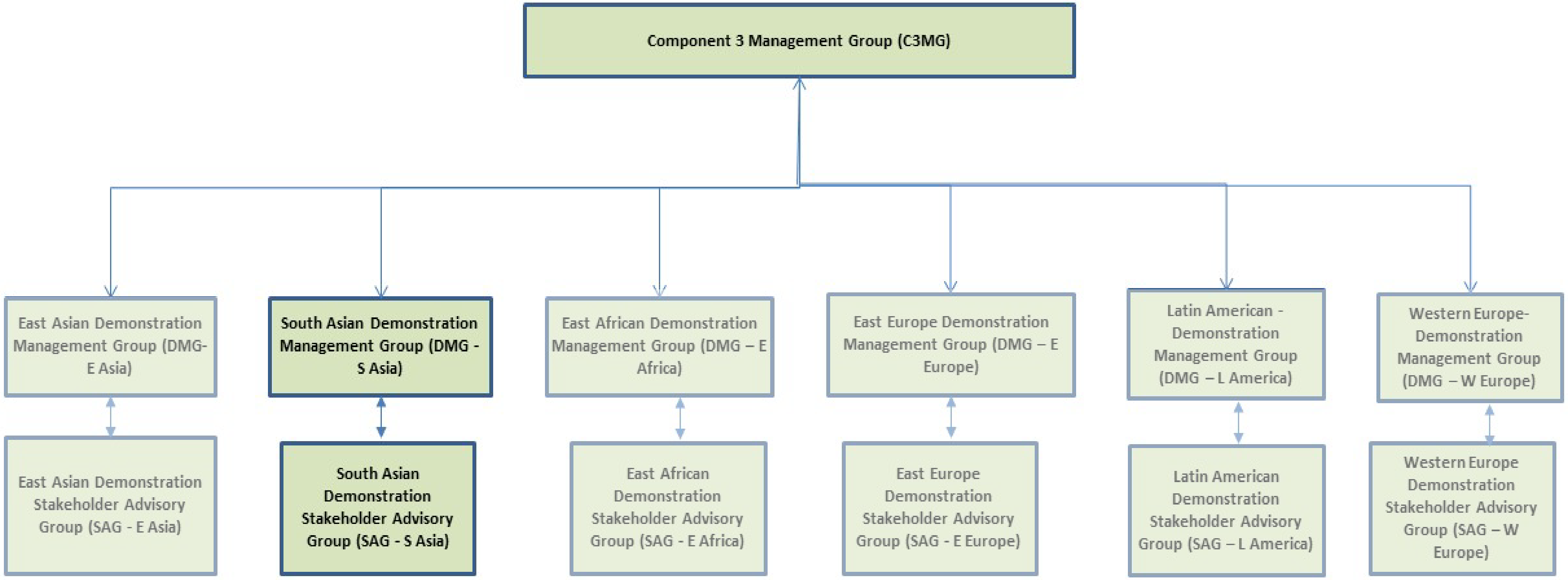
3.7.1 Communication strategies

Research publications in professional journals and informal dissemination through print and electronic media will be the strategy for broadcast-style global and local communication, whereas more targeted communcations with stakeholders would need meetings, group discussions, workshops, e-mails etc. South-Asian regional contributions will also be made to the overall INMS global communications, through its website, newsletter etc.

3.8 Execution arrangements

'Demonstration Management Group' (DMG) (see Figure A17b5), consisting of the director (Prof. N. Raghuram, GGSIPU and Vice-President, SCON), other members if the project office, representatives from the countries/institutions involved and other key members taking on specific tasks and roles. This group will be chaired by Prof. Abrol, President of SCON, to hold regular meetings, to review and approve Task Outputs and Interim Task Outputs and to provide regular reports to the Component 3 Management Group (C3MG), Project Management Board (PMB) and the Project Co-operation Unit (PCU).

A **'Stakeholder Advisory Board' (SAB)** will also be created, consisting of industry, civil society and scientific experts, who will meet to review and advise the DMG on activities.



A17b5:*Demonstration Stakeholder Advisory Group' (SAG), will engage with the work of the DMG, provide responses to consultation, review work of the Tasks etc as required*

4 Monitoring and Evaluation

4.1 Demonstration Project Results Framework

The present detailed log-frame (project results framework) covers aspects that are specific to the South Asia Regional Demonstration. It should be read in conjunction with the project results framework for Component 3 as a whole (see Appendix 17), which emphasizes common aspects between the different INMS demonstration regions.

	Objectively Verifiable Indicators			Sources of Verification	Assumptions
Outcomes, Outputs and Activities	Indicator	Baseline	Target		
Outcome 4: GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised	Project-level demonstration methodology guidelines adopted and published Requests for and application of demonstration area methodologies, tools and practice by external parties	Limited information from previous GEF interventions and partial N budget recently developed.	Project level methodology developed and agreed. Uptake of demonstration area methodology in other areas.	Workshop reports Contribution to synthesis documents	Active participation of the populations and policy makers in South Asia Availability of diversified expertise and technologies in South Asia

Output 3.1: A demonstration activity which delivers conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing: Case 1: Challenges and opportunities for developing areas with excess reactive nitrogen.	Report on N sources and N flows for South Asia. Report on consensus on N priority sources, forms and impacts for South Asia. Regional condition according to agreed N performance indicators. Information on priority N management and mitigation options. Information on successes and opportunities.	Lack of joined up data on N sources and flows regionally. Lack of knowledge on how N sources and impacts fit together. Lack of knowledge on how different N indicators relate, especially at regional level. Diversity of views and lack of consensus on the best methods to obtain N co-benefits. Variable progress, with limited attention to linking N co-benefits	Quantified N flows, with uncertainty indication by end Year 3. Clearly identified priorities for N sources, forms and impacts by end Year 3 Statement of South Asia performance in using agreed N indicators by end Year 3. Draft 'Top 10' priority measures for improved N management for South Asia (end Year 2). Document for South Asia, showing how N approach can address barriers and share success stories (Year 4). Global scenarios informed by evidence from South Asian Demonstration (Year 3).	Reports, contrib'n to global synthesis (A2.2). Reports of science-stakeholder workshops. Report and contribution to INMS publications. Report provided to A2.3 for incorporation in global comparison. Documents for South Asian demonstration.	

	Information on regional specificities for global scenarios	Existing global scenarios paying insufficient attention to regional conditions.		Report from A2.4 workshop.	
The following topics are also included: • Regional demonstration to increase Nitrogen use efficiency (NUE) in South Asia	Field trials in regional demonstration activities show an improvement of 20% in NUE [SR]: Adoption of agricultural technologies to improve NUE	Low efficiency of N in South Asian agriculture	Field trials in demonstration region (Yr 4): Increase NUE at scale by 20% of the baseline level in test plots shown	Reports from C3 Management Group	Known co-financing at selected demonstrations will allow field trials. Field trials in other demonstration areas will be subject to the availability of additional co-financing.

Annex 1: Terms of Reference for Partners / Key Consultants

Terms of Reference for the roles of Demonstration Project Co-ordinators and Project Officers along with potential consultants, is included in Appendix 11. The remit of these roles, along with decisions on the institutions and persons taking on these roles for each Demonstration Region, will be subject to endorsement by the Project Partners Assembly at the Inception meeting of the project.

Annex 2: Details about Demonstration Region

The SAARC countries (Annex 2, Figure 1) will be the main target of this study, with the main focus on India, Bangladesh, Sri Lanka and other countries to the extent possible. Through Indian lead researchers in various aspects of the N cycle and their peers/partners in each of these South Asian countries, relevant unpublished secondary data and information will be collected from the respective national government agencies and private organisations. In addition, published data/information will be collected from professional literature such as journals, books, websites etc. Visits to sites/countries of the region will be undertaken as needed.

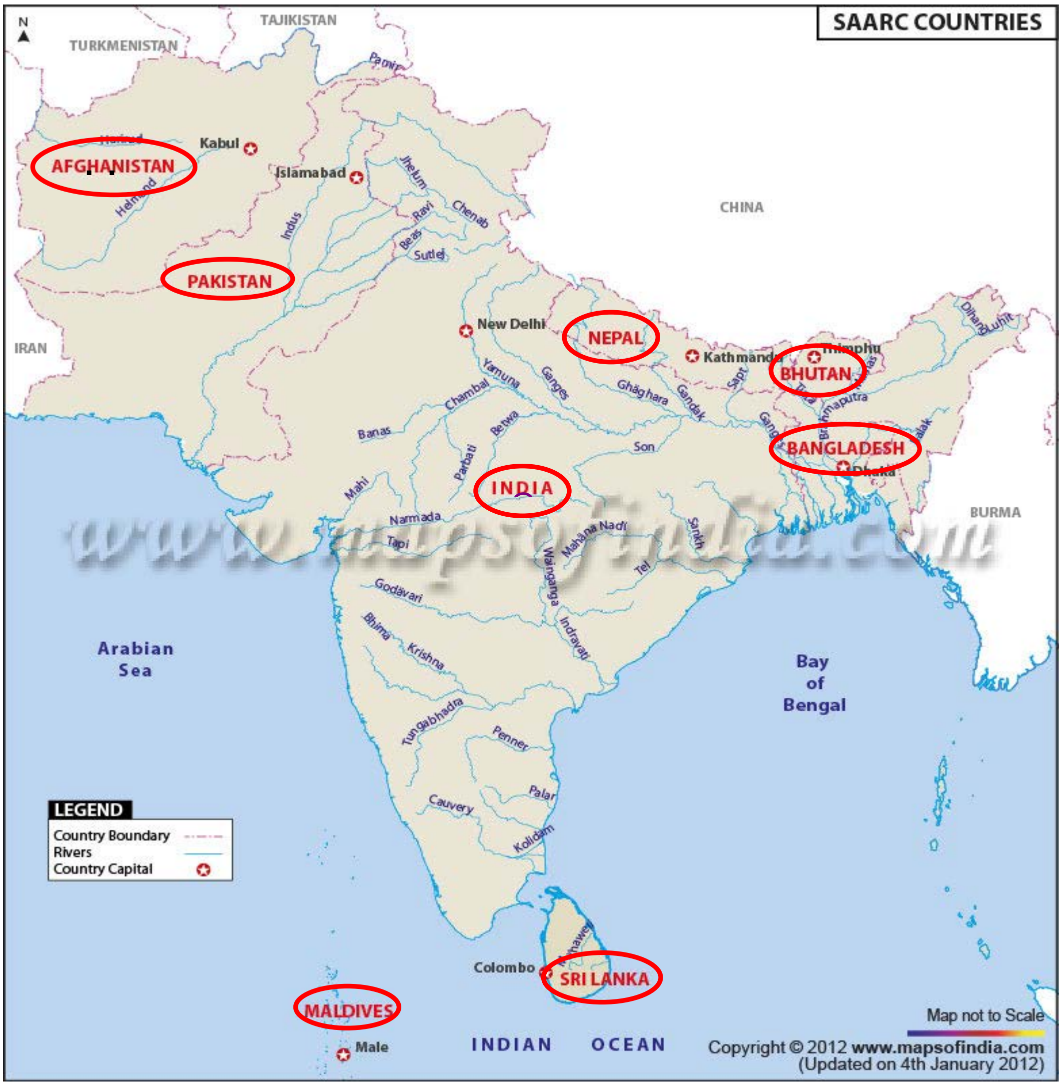


Fig. 1 A map of SAARC countries marked in red circles selected for South Asia Demonstration 'Towards INMS' study on solid waste sector [Map courtesy: Mapsofindia.com]

Annex 3: Draft minutes from 'Reactive Nitrogen Assessment in South Asia', New Delhi, February 2016

(Draft summary of the workshop held at NASC Committee room no. 1 on Feb. 26-27, 2016)

The nitrogen cycle is anthropogenically the most disturbed nutrient cycle having adverse impact on almost all ecological compartments and resultant ecosystem services. Such perturbations have adverse impacts on food security, energy, industry, human health, biodiversity, environment and climate change. Reactive nitrogen (Nr) includes inorganic (from both sides of the redox range including NH_3, NH_4^+, NO_x, N_2O, NO_2^-, NO_3^-) and organic (urea, amines) variants that readily interact in the environment including air, water and soil. Anthropogenic creation of Nr is primarily from agricultural activity through the use of fertilizer N and from combustion of fossil fuels. Agriculture being the major activity in the south Asian region to feed its teeming billions, use of nitrogenous fertilizers have grown during the last two decades by leaps and bounds and is increasing further. Taking a stock of N-footprints can help us to understand better on how our activities are contributing to the creation of Nr, how these activities are affecting our environment and how it can help us develop solutions for reducing the impact of Nr. This was discussed by around 30 delegates including representatives from various south Asian countries, members of International Nitrogen Initiative (INI) and select Indian researchers active in the field of study. The workshop held on Feb. 26-27, 2016 was organized by the **Indian Nitrogen Group (ING-SCON)** and **South Asian Nitrogen Centre, New Delhi**, hosted by it with active support from INI and **International Nitrogen Management System (INMS)**. The objectives of the two day discussion was to take a stock of current scenario in different sectors of the economy and identify active scientists, various Institutes/ organizations and the range of areas/topics in different sectors including agriculture, livestock, fisheries, energy, industry and health. This meeting was expected to help identify develop groups of researchers in south Asian countries to decide on**: Collation, Evaluation, Analysis, Re-evaluation, Synthesis, Documentation and Communication** on Reactive-N status in south Asia.

More than half of world's population owe their food to synthetic nitrogen (N) fertilizer made possible by the invention of the Haber-Bosch process in the early twentieth century. Although N is abundant in the atmosphere (more than 2/3rd of the atmosphere) this is not available to the life forms for cellular processes and needs to be converted to its oxidized or reduced forms, aptly called reactive N, for use. As a pillar of the green revolution, synthetic fertilizer enabled farmers to transform infertile lands into fertile fields and to grow crop after crop in the same soil without waiting for nutrients to regenerate naturally. Unfortunately, a large part of this reactive N leaks into the environment and upsets the global biogeochemical cycle of N. Further with the demands of the modern society increasing spatially and temporally, other sources of reactive N release to the environment including industry, energy generation and wastes also contributed to the anthropogenic alteration of the N cycle. The uncontrolled accumulation of reactive forms of N in soil, water and air not only causes pollution, ill health and adversely impact biodiversity, but also exacerbate climate change and associated challenges.

Thus, identification of all the significant sources of reactive N flows and their relative contribution to the **National/Regional/Global N cycle** are most important for informed decisions on the policy on sustainable N management for food security, energy, industry, health and environment (Zhang et al., 2015). USA through the North American Nitrogen Centre (www.nitrogennorthamerica.org) and Europe through the European Nitrogen Assessment (www.nine-esf.org) had already made considerable progress on collating information on the reactive N status on a continental scale.

The inaugural session began with a welcome by **Prof. Tapan Adhya**, Vice-President, ING-SCON and Director, South Asian Nitrogen Centre, New Delhi. In his brief inaugural address, Prof. Adhya mentioned that South Asia consisting of Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka are the home of about 24% of the global population with only 4.9% of the world's land mass, 15.4% of the global arable land, 2.98% of the world forest area and 4% of the world's coastline. Except for Maldives, the role of agriculture in South Asian countries is notable, playing a very significant role in national economies and rural livelihoods. While the world demand for total fertilizer nutrients was estimated to grow at 2.0 per cent per annum from 2011 to 2015, growth rate in South Asia was higher. Total fertilizer nutrient consumption in Asia is 60 per cent of the world total, and South Asia is the second largest fertilizer consuming region in the world with consequent pollution especially related to fertilizer overuse. Prof. Adhya requested the audience to make effort in quantifying the N balance of agro-ecosystems and prepare estimates for N flows. This was followed by a self-introduction of the assembled participants.

The tone of the workshop was set by **Prof. Himanshu Pathak** of Indian Agricultural Research Institute, New Delhi through his presentation entitled, "**Reactive Nitrogen Assessment in South Asia**". Prof. Pathak raised several issues including (a) Why to assess reactive N? (b) What is the current state of knowledge? (c) How to assess the reactive N? (d) What are the objectives of the Workshop?, and (e) How to proceed with it? He mentioned that globally, use efficiency of external N supply is as low as 30-35%. However, N-use efficiency in terms of the amount of N actually consumed to N produced by Haber-Bosch process is much lower. For a vegetarian the efficiency is 14% whereas for a non-vegetarian it is merely 4%. Thus, the unaccounted for 86% or 96% of N, depending upon the food choice, represents the tentative loss of N fertilizer into the environment, a serious concern. Soil N dynamics is an integral component of global N cycle, since a single N molecule (N_2) introduced in the system can have cascading effects in various components of the environment, after it has been converted to reactive N forms, either reduced or oxidized. Nitrous oxide, a greenhouse gas is responsible for global warming and climate change. Prof. Pathak informed that problems with N pollution is also a part of the solution and thus requires a careful scrutiny by all concerned.

Prof. Raghuram of ING appraised the audience about the various global initiatives on reactive N assessment. He mentioned the need for upscaling of the reactive N assessment from national to regional level ultimately reaching to a global perspective. He informed the audience that SANC requested INMS/GEF to take regional inputs before working out a global assessment. Prof. Raghuram also mentioned that GPNM of UNEP has focused on two locations namely, Chilika lake in India and Manila bay in Philippines to arrive at a common target for nutrient loss reduction. Results from the two sites projected contrasting outcomes indicating an overwhelming impact of agricultural pollution in an otherwise urban milieu (Manila Bay) and vice versa. The event at Chilika Lake which led to the publication of ecosystem health cards, was also supported by SANC. He mentioned that South Asian Co-operative Environment

Program (SACEP) based in Colombo, Sri Lanka has come out with a "Scoping study on Nutrient loading and eutrophication of coastal waters of the south Asian seas" wherein basic details of nitrogen loading in the south Asian environment has been analyzed. Obviously, our aim should be to reduce the pollution from leakage of added nitrogen, basically the most important nutrient, to the environment and this can be achieved by a judicious reduction of fertilizer use. He informed the workshop participants about the earlier initiative by ING and its close interaction with the International Nitrogen Initiative and South-Asian Nitrogen Centre. Prof. Raghuram also requested all the country representative of south Asian region to prepare a list of institutes in individual countries engaged in such work which can be used for information exchange.

The next presentation was made by **Prof. Mark Sutton**, NERC Centre for Ecology & Hydrology, Edinburgh, U.K. and Chair, International Nitrogen Initiative (INI). He mentioned that biogeochemical flows of N has already crossed the 'planetary boundaries' and is likely to affect the biosphere integrity in an adverse way. Prof. Sutton mentioned that for European Union (EU), where an assessment on the reactive N issue has already been completed, the projected damage cost of nitrogen pollution hovers between € 70-320 billion/year. Drawing reference from IASI satellite pictures for Global ammonia column (mg m^{-2}) he referred to the huge plume of atmospheric column of ammonia over Indo-Gangetic plain and adjoining areas and mentioned that south Asia is a hotspot for N losses especially from N fertilizer use and livestock sector. He mentioned that forms of nitrogen vary from sector to sector and while NH_3 and N_2O is mainly contributed by agriculture, NO_x is attributed to fossil fuel burning. Prof. Sutton mentioned about the International Nitrogen Management System (INMS) which focuses on bringing various scientific evidences together to inform policy-makers and the public on the multiple benefits and threats of reactive nitrogen and how we can all benefit by addressing it. INMS is being developed as an international process with funding from the Global Environment Facility (GEF) and builds on and links together existing nitrogen networking activity. He detailed the different elements of INMS including C1 that deals with tools and methods for understanding the N cycle, C2 that deals with global and regional quantification of N use, flows, impacts and benefits of improved practices, C3 dealing with regional demonstration and verification and C4 involving awareness raising and knowledge sharing. He mentioned the different country clusters including **South Asia (**India, Sri Lanka, Bangladesh, Nepal and Maldives), **East Asia (**China, Japan, South Korea, Phillipines), **Lake Victoria Basin (**Kenya, Uganda, Tanzania, Rwanda, Burundi), **Latin America (La Plata) (**Brazil, Paraguay, Uruguay, Argentina, Bolivia) and **Black Sea** (Diester, Prut and Lower Danube). Prof. Sutton informed that there is an urgent need to understand the full chain of NUE. He informed the delegates that the European Nitrogen Assessment involved 200 experts, 21 countries and 89 organizations and the Global nitrogen Assessment should be on a much bigger scale involving perhaps 500 experts, 50 countries and 100 organizations. He requested the regional group of South Asia to gather information, their evaluation and subsequent documentation for a meaningful assessment.

Dr. S. Ayyappan, President, National Academy of Agricultural Sciences, India and Chief Guest on the occasion mentioned that because of long term scientific studies by the Indian researchers, quantity of data available in the country is quite large and should now be compared and integrated with the data from countries of south Asia as the first stage of consolidation on a regional basis. However, there is a need for farm level verification and field validation of the data, and associated modelling efforts. He mentioned that with the continued lowering response of crop varieties to N fertilizer application, farmers tend to apply more and more fertilizer as they have the onerous task of feeding the billions in the region. Thus, the agenda of N-use should be carefully drafted. He urged the researchers to explore alternatives for chemical N fertilizer that could minimize both loss of this valuable nutrient and resultant pollution. He reemphasized the need for listing the institutions working in the area of N use and urged the delegates to explore possibilities of sharing and exchanging data on a regular basis, including data from different other sectors. He advised the delegates to develop awareness program through social media for prudent handling and judicious use of N fertilizers as this will contribute to a great extent to the well-being of society and serve great cause for the science apart from reducing pollution. In conclusion, he mentioned that the canvas is large and overlap is very likely. However, conscious effort should be made to optimize N-use efficiency in the country cluster of south Asia, as has already been shown by Bangladesh through introduction of legumes in rice fallows. He thanked the organizers for giving him an opportunity to participate in the meeting.

The inaugural session ended with vote of thanks by **Dr. M.K. Tiwari**, Vice-President ING, who thanked all the participants for their wholehearted approach in discussing the issue of reactive N. He specially thanked the delegates from abroad who made serious efforts to participate in the workshop at a short notice. He also thanked ING-SCON and SANC to organize and host the workshop and the INMS and the Ministry of Earth Sciences, Govt. of India for funding the workshop.

The second session of the workshop was devoted to **Reactive N footprint in soil-crop-environment** in different countries of south Asia. Setting the agenda for the Session, **Dr. A.K. Sikka**, Dy. Director General (NRM), ICAR, New Delhi, who also chaired the session, mentioned that reactive N assessment is important from the viewpoint of productivity as well as climate change. However, in spite of putting a heavy burden on exchequer, more than 60-70% of fertilizer used in agriculture goes waste. He noted that it is a moot issue how to reduce different Nr components in the environment. Innovative fertilizer management schedules like site-specific nutrient management (SSNM), slow-release N-fertilizers like neem-coated urea, customized fertilizers, fertigation and deep-placement of urea are commendable steps in this direction. This could be aided by specific conservation agriculture practices like direct-seeded crops, residues conservation and recycling technologies, use of leaf colour charts etc. However, there is a need for more number of practices to increase NUE because if NUE is not managed properly it will lead to loss propositions.

In a special presentation on Integration of N science and policies – Industry view, **Dr. R.K. Tewatia**, Additional Director (Agricultural Sciences), Fertiliser Association of India, New Delhi, informed the delegates that South Asia accounts for 11% of global N production and 19% of global N consumption. All the South Asian countries are deficit in fertilizers and raw materials and depend on import of fertilizers to meet demand. Among the major South Asian countries, fertilizer N consumption (kg/ha) follows the order of Bangladesh (144.7) > Pakistan (101.8) > India (98.5) > Sri Lanka (78.2), but the ratio of N, P and K use is more balanced in Bangladesh as compared to India. Describing the India-specific scenario Dr. Tewatia informed that there has been a remarkable growth in the production and consumption of N fertilizers in India after '60s and currently India is the 2^{nd} largest producer and user of N in world. Energy efficiency of the Indian N fertilizer plants is one of the best and there has been a 32% reduction in energy consumption in the urea plants over the last 25 years. Indian gas based ammonia plants are the lowest energy consuming plants (8.29 Gca/t ammonia) in the world. However, not much growth has taken place in Indian nitrogen industry during the last two decades, due to prevailing unfavorable policy environment as fertilizer is a highly regulated and Govt. controlled commodity. Further, although number of policies have been implemented to promote increased and balanced use of fertilizer, urea is under statutory price control (Farmers price fixed; subsidy variable) and such distortion in urea (N) vis-à-vis P and K fertilizer prices induced imbalanced fertilization and is responsible for inefficient nutrient use. Fertilizer industry recognizes 4R Nutrient Stewardship as an appropriate framework to guide management decision for sustainable N management. Industry also desires for a direct transfer of subsidies to the farmers than reimbursing it back to the industry enabling it to concentrate on developing innovative efficient fertilizer products and improving farmers' awareness on fertilizer-based crop management policies. However, based on recommendations of task force on 'Balanced Use of Fertilizers' following policy developments have recently taken place: (a) Policy to promote fortified & customized fertilizer to correct deficiencies of secondary and micronutrients (2008) (b) Policy to promote Neem coated urea (2008) (c) Extension of subsidy to S and micronutrients (Zn & B) under NBS (2010) (d) Freedom to introduce new grades of WSFs by notifying general specifications of WSFs (2015) and (e) Policy to promote city compost (2016). It is expected that such pragmatic policy decisions on behalf of the government will bring new initiative in improving N fertilizer use in Indian agriculture.

In this session on country specific presentation **Dr. Jatish Chandra Biswas**, Chief Scientific Officer, Soil Science Division, Bangladesh Rice Research Institute, Bangladesh presented on "Reactive Nitrogen in soil-crop-environment in Bangladesh". Dr. Biswas mentioned that N constitutes about 75% of total nutrients used in Bangladesh and rice crop consumes 2.442 million tons of urea fertilizer. Like any other country, Bangladesh is saddled with the low NUE in crops and devised innovative approaches to increase the N-fertilizer use efficiency including use of urea super granules (USG), deep placement of urea, use of bioorganic fertilizers and using low input variety. He informed the audience that such measures have increased rice yield to the tune of 15-20% and reduction in the use of urea fertilizer to an extent of 20-30%. Livestock and poultry serving the growing protein demand, their rearing also helps to get organic manure equivalent to 0.66 million tons of urea. He mentioned that fish rearing is a profitable enterprise in Bangladesh and large amounts of organic and inorganic nutrients and feeds are used for this purpose. However, N-use for semi intensive fishpond is 28 kg ha/week and while feed contributes about 250000 tons N, recovery efficiency is only 9-30% causing a large amount of N leakage from aquacultural resources.

Dr. K.R. Dahal from the Institute of Agriculture and Animal Science (IAAS), Tribhuvan University, Rampur, Chitwan, Nepal in his presentation entitled, "Nitrogen and its management in Nepalese farming systems". Agriculture is the mainstay of the Nepalese economy, with more than two thirds of the population deriving their livelihood from agriculture contributing about one third to GDP. People, who practice subsistent farming, still heavily rely on the local inputs such as FYM, forest litters, crop residues and composts. Intensive farming and commercial cropping consume chemical fertilizers as per the availability and need, and are often misused, especially nitrogenous fertilizers Research and development on nutrient management in Nepal is mostly focused on fixing the doses of fertilizers through crops based traits and laboratory tests of available nitrogen. Research on enhancing nitrogen use efficiency to some extent is also on the agenda. However, the discussion about the reactive nitrogen, their sources, forms and fate in agriculture and the environment have not yet entered in the main discourse of research. N management options have been suggested through an integrated approach to limit N production and its use so that the critical environmental limit is not exceeded. N supply should match the N demand in time and space, not only for single crop but for crop rotation as an integrated system, in order to achieve a higher agronomic NUE. Various practices such as site specific nutrient management, SSM, use of LCC, SRI, application methods, etc. are becoming popular. A combination of quantitative systems research, development of best practices and legislation will be needed to develop more environmentally-friendly agricultural systems in Nepal. The growing complexity of managing N for sustainable agricultural systems calls for problem-oriented, interdisciplinary research and regional collaboration on N management (including all its reactive forms) is sought to make agriculture and environment robust, and the planet healthy. He also provided a list of institutions in Nepal that are engaged in research on N in agriculture and environment.

The next presentation in the session was made by **Dr. S.P. Nissanka** of University of Peradeniya, Sri Lanka. He mentioned that Sri Lanka imported 0.6 million tons of fertilizer in 2012 of which ~50% is urea. Around 60-65% of the imported urea was used in paddy cultivation while the rest was applied mainly in plantation crops (tea, rubber, coconut, vegetable cultivation). As per published literature, recovery of applied N is 15-30% as compared to the average figure of ~31% for Asia, indicating huge loss of applied N. These losses may be even higher depending on the method of application and the source used. Massive amount of N is lost in various ways including losses as N_2O and emission from urea fertilization has been accounted for at 821 Gg CO_2 eqv. or approximately 52% of total urea applied. In view of high economical and environmental costs, attempts to increase NUE are being made through (a) Biological nitrogen fixation through legume based agroforestry, (b) Integrated nutrient management, (c) Site specific fertilizer application, (d) Use of slow release efficient nutrient source and formulations, (e) Application of prescribed rates; split application, (f) Promotion of organic agriculture and (g) Use of Nitrification and Urease inhibitors. However, main limitations include information availability, advanced research, and awareness and cost effective fertilizer sources. In the second half of the presentation, **Dr. R. Piyadasa** of the Department of Geography, University of Colombo, Sri Lanka detailed experimental results on groundwater pollution in the coastal aquifers of Kalpitiya and Jaffna peninsulas, Polwatta River and Weligama Bay, inlets of Diyawanna lake and Kurunegala lake. Overall results indicate Nitrate contamination pattern in ground water of some localized areas are shown as high as >10mg/L whereas average value of more than 5mg/L of shallow ground water was reported in many villages of Kalpitiya and Jaffna areas. It was recommended to implement best management practices with strict control of chemical fertilizer application, proper maintenance of wells and provision of proper distance between wells and sewage pits to rectify the contamination of nitrate-N to groundwater resources..

Dr. Gufran Beig from Indian Institute of Tropical Meteorology, Pune, India spoke on reactive N and air quality in south Asia. He mentioned that NO_x in the atmosphere is a major gaseous reactive N form whose ambient health hazard threshold is 41 ppb and toxic effects are noted above 250 ppb. The gas mostly originating from internal combustion of fossil fuels, causes nose and eye irritation, lung tissue damage, pulmonary edema (swelling), bronchitis and aggravate existing heart disease. Also originating from anthropogenic activities like biomass burning, NO_x has in Indian sub-continent is being measured and monitored through specific onsite measurements and modelling. Trends in NO_x monitoring indicate that growth of NO_x emission during 1991-2001 was 52% (1487 Gg/yr while growth during 2001-2011 was 69% (2972 Gg/yr). Using 3 global models towards projecting 2050 scenario of NO_x emission in South Asia with 2010 as base year indicate high amount of emission in Indian subcontinent including Pakistan, India, Bangladesh and Myanmar. There is also evidence of large scale transport of pollutants from South-East Asia to East Asia and vice versa. During monsoon, mostly south westerly wind from oceanic region transports pollutants from South Asia to East Asia while during post monsoon period, north easterly wind helps to carry the pollutants from East Asia towards South Asia. Dr. Beig mentioned that in view of increased anthropogenic activities in the region including higher energy demand, increased fossil fuel and biomass burning and lack of policy initiative to upgrade the internal combustion engines, reactive N control is going to be a strategic challenge. This was followed by a question-answer session for all the presentations made during the session. Prof. Mark Sutton stressed that there is a need to capture NO_x by innovative methods and high NO_x in the atmosphere is increasing NUE through higher deposition, but on the other hand decreasing NUE by promoting the formation of tropospheric ozone. Prof. U. Kulshrestha of Jawaharlal Nehru University, New Delhi decreasing NO_x in the atmosphere would require a 30-40% reduction in petrol/diesel consumption.

The post-lunch session on "**N flows in different sectors: Indian and South Asian scenario"** was chaired by Prof. Mark Sutton which was designed in the format of an interactive session.

The first presentation on 'Reactive N from Fisheries and aquaculture in South Asia was reviewed by **Dr. K. Vass,** Ex-Director of Central Inland Fisheries Research Institute, India. He mentioned that fisheries *per se* do not contribute much to the reactive N in the environment rather soil and water transported from agricultural fields to aquaculture contributes to N contamination and affect quality of surface water. He pointed out South and East Asia together contributes a large share to the global aquaculture production with India occupying 3rd position in fisheries and 2nd position in aquaculture. Dr. Vass referred that in ponds and other inland capture fisheries, N can act as nutrient but also sometimes doubles as pollutant leading to eutrophication, and could be better dealt with through upstream management practices. Similarly brackish water aquaculture influences and are influenced by N flows in coastal waters. He mentioned that while voluminous data has been collected, it requires to be brought to a common platform for an universal analysis and modelling. Different levels of efforts are required if we have to understand the contribution of N cycle in the aquaculture sector in the South Asian region. Dr. J.C. Biswas of Bangladesh mentioned that rampant contamination of aquacultural resources including rivers and ponds as well as wetlands is reducing the diversity of fish population in Bangladesh. Dr. Mizanur Rahman of Bangladesh mentioned that combined experimentation was done by Bangladesh Myanmar, Thailand and Vietnam to study the impact of application of extra fertilizer on fish production as well as environmental losses of N. International agencies like BoBLME is doing extensive investigation in the coastal areas of Bay of Bengal. Prof. Mark Sutton suggested working out threat assessment from aquaculture.

Dr. Asha Ram of Central Agroforestry Research Institute, India noted that the current area under agroforestry in India is estimated as 25.32 million hectares (m ha) or 8.2 per cent of the total geographical area of the country. He mentioned that Agroforestry systems may serve as both a source and sink of reactive nitrogen. He pointed out that legume-based agroforestry has the potential to transfer substantial amounts of nitrate into local water supplies increasing concentrations above the safe drinking levels. However, there is also the possibility of reducing external input of fertilizer-N in agroforestry based systems like through use of Rhizobia and actinorhiza harbouring tree species tolerant to salinity, extremes of soil pH, desiccation and high temperature. Research in agroforestry is a lengthy undertaking and requires proper planning and implementation. In the next presentation, **Dr. Bhola R. Gurjar** from the Department of Civil Engineering, IIT Roorkee, India referred to health sector and reactive-N issue for South Asia. He discussed about the impacts of excessive reactive on human and referred to the national concern to environmental pollution in the Indian capital of Delhi.

In the ensuing discussion, session chair Prof. Sutton mentioned about INMS demonstration and suggested change in the mindset of policy makers for reduction of reactive N in the environment. He mentioned that bioaccumulation of nitrate in leafy vegetables is an issue of concern. Dr. H. Pathak wondered why there is no WHO limit for total daily uptake of nitrate or nitrite. In subsequent discussion on gathering dataset on a unified format, Dr. N. Raghuram suggested country representatives to associate partners from different sectors in the context of individual countries in order to have a comprehensive representation. He mentioned that the level of data collection should be at provincial one but county level dataset is welcome. Dr. H. Pathak advised the group to develop datasheet in excel format (with unit of the variables). Dr. Nissanka of Sri Lanka requested the organizers to develop the spread shoot tool and then to identify the gaps in data availability

On the day 2 (Feb. 27, 2016), first presentation was made by **Dr. S.K. Mahanta** of Indian Grassland and Fodder Research Institute, Jhansi, India on reactive N in grasslands. He stated that about 10.15 mha i.e. 3.1% geographical area of India is having grassland that provides forage to livestock (>40% of total livestock), protects and conserves natural resources and biodiversity, and other ecosystem services as well as enhance attractiveness to landscape. While application of N produces higher biomass, influence of nitrogen on herbage composition, yield and quality has not been studied in detail. Grassland nitrogen in herbage on consumption and utilization by ruminant animals is converted to animal protein. However, nitrogen budgeting in tropical grasslands is not well-delineated and only theoretical valuation of N-input and N-output values are considered.

In the next presentation, **Dr. A.L. Ramanathan** of Jawaharlal Nehru University, New Delhi discussed about coastal ecosystems and mangroves. He mentioned that mangroves which act as interface between land and open sea acts as the major C-sink and also storehouse of N washed through riverine discharge, before they are upwelled to the sea. He mentioned that intensive study on the Sunderban mangroves which is shared by both India and Bangladesh provides a perfect case study, where the organic matter content is more in the Bangladesh side of the mangrove. Using several techniques including δ^{13}-C ratios and molecular biomarkers contribution of C:N raios in the organic matter is being studied. Seasonal N fluxes from select mangroves have been quantified which indicate significant N_2O and NH_4^+ flux. However, the open sea deposition of reactive N is induced by the acidification index.

Dr. C. Sharma of National Physical Laboratory presented on Reactive-N in Energy, Industry and Transport in South Asia. He mentioned that all the target sectors are anthropogenically influenced and contribute to reactive N in the environment. Among the various sectors, only transport has a defined IPCC protocol for quantifying N release. He stated that specific case studies may not be available for the representative sectors but fuel-use based methodology has been tried for the transport sector which however does not match and conciliation is necessary. He mentioned the possible data sources can be National Communication submitted by all the member countries to UNFCCC. Almost all the South Asian countries have already submitted the second report upto 2010 and some countries have topped it up with biennial reports (BAR). Apart from that pre-publication database, institutional publication and other credible sources could be used for collation of data. 2010 should be taken as the base year and data analyzed.

Dr. Ranjan Bhattacharya of Indian Agricultural Research Institute, New Delhi presented a report on Reactive N and soil quality. Dr. Bhattacharya drawing from his draft chapter on Indian Reactive N and soil quality, mentioned that biogeochemical models could define N sequestration in soils on a global scale but it would be more prudent to use models based on field measurements. He mentioned that N fertilizer is a potential contributor to soil acidity and it has great influence on soil biota, soil organic matter and soil aggregation. Question arises whether high N input could impact soil quality. In long-term fertilizer management studies across the world indicted that use of N-fertilizer as compared to unamended soil records higher microbial biomass and the scenario becomes better when chemical fertilizer is used in a balanced way with involvement of major plant nutrients in conjunction with N. Given the limited and sometimes conflicting reports of fertilizers in relation to soil health, combined with the lacuna in identifying many soil organisms, there is a clear need to reconcile conflicting data and to explore the unknowns. While several studies have identified crop residues and other organic material in terms of their effects on soil health, a range of residues need to be considered, from soluble and readily decomposable legumes to lignified resistant material in cereal straw. He emphasized the need of research on soil quality following application of chemical N-fertilizer vis-a-vis organic matter. This becomes necessary as policy makers on one hand is urging increasing levels of chemical-N while specific niche areas are being recommended for organic cultivation for economic reasons.

In the next presentation, **Prof. U. Kulshrestha** of Jawaharlal Nehru University, New Delhi discussed about “Atmospheric deposition of reactive N in South Asia”. He categorized the atmospheric deposition into wet and dry categories and compared between urban and rural areas. He recorded that while in rural areas NH_4-N is lower and NO_3-N is higher in quantity. The scenario gets reverse in industrial areas where NH_4-N content is higher. Total ammonium deposition from fertilizer and livestock amounted to 2039 Gg as compared to 44,000 Gg representing approximately 4% of global emission. He suggested that high amount of ammonium in the Indian atmosphere could be due to high human and cattle population, intensive agriculture, biomass burning, disposal of untreated sewage and municipal wastes and above all alkaline nature of aerosol and dust particles in Indian subcontinent. Dr. Kulshrestha commented that good quality data availability is limited on N depositions from SA region. The major reason is the delay in chemical analysis due to which both NH_4 and NO_3 are underestimated. Also trajectory analysis with deposition studies to understand long range transport of pollution is essential. In conclusion, he mentioned that (1) dry deposition studies of Nr are more important than wet deposition in India which needs to be investigated; (2) among N-NH_3, N-NH_4 and N-NO_3, gaseous ammonia contributes highest nitrogen in the atmosphere in India; (3) higher N-NH_4 than N-NO_3 in Rain water and (4) Indo-Gangetic region has highest wet deposition of N-NH_3.

In the second session for the day on ‘**N policies and challenges for South Asia’** Prof. Mark Sutton reiterated the Global science support for international N policy development in the form of INMS. He mentioned that INMS builds on and links together existing nitrogen networking activities. **Prof. H. Pathak** listed national policies for nitrogen use in agriculture in India. While there are several policies in agriculture that overlaps with N-use directives, there is lack of synergy and it is essential that such synergy is achieved at the earliest for reducing soil, land and water pollution for unlimited use of N-fertilizers. Dr. Pathak commented that this issue could be universal with almost all the countries in South Asia because of agrarian focus. **Dr. M.K. Tiwari** of ING emphasized the necessity for an effective policy for N-use and losses in the different countries of South Asia. He expressed apprehension that absence of policy can lead to misuse of natural resources while at the same time any uniform policy across the country can create issues because of the huge diversity across the country. Simple tools for projecting assimilative capacity of the environment and threats are necessary to sensitize policy makers particularly if damage is not easily visible as in case of reactive N.

In the final discussion session, delegate from Nepal expressed concern at the lack of implementation of strategies to control N use. Delegate from Sri Lanka mentioned prevalence of kidney diseases and other health concerns in areas with high NO_3 content in groundwater and expressed realization among policy planners towards regulated N-use. Delegates from Bangladesh mentioned that fertilizer subsidy has helped in the increased use of fertilizer and consequent high productivity. However, overzealous use has often resulted in large-scale contamination of the environment. Prof. Mark Sutton suggested changes in policy and to be positive in policy analysis that will benefit one and all as far as reactive N is concerned. He mentioned that while policies are in place it is difficult to understand why some policies get implemented while others are ignored. He suggested linking INMS to other International Nitrogen Policy Frameworks like UNFCC (climate), LRTAP (air quality), GPA (marine), CBD (biodiversity), Montreal Protocol (stratosphere), UNEA/OECD (policy arena for nitrogen). The following recommendation emerged:

1. National nutrient management network in all South Asian countries.
2. Putting in place nitrogen assessment protocols for all the sectors responsible for release of reactive N.
3. Making data available to all the end-users. It was suggested that SACEP and SAARC council for Science & Technology may be tapped for data access in the different countries of South Asia.
4. For getting data on environmental issues, it was mentioned that since all the South Asian countries being signatory to Male declaration, accessibility to data may not be difficult.
5. All the countries were urged to develop informal working group among the various institutions in their own country and proceed towards documenting features for managing reactive N issues.

The meeting ended with a vote of thanks given by **Dr. Arti Bhatia**, Jt. Secretary, ING who thanked one and all for whole-hearted participation and expected a defined work plan to emerge in the form of South Asian Reactive Nitrogen Assessment. She specifically thanked the delegates from South Asia whose participation made the workshop more meaningful and hoped that the delegates after going back to the country will develop contact with their colleagues and help sensitize the policy makers in their own country for an efficient N-use strategy and avoidance of reactive-N contamination.

Programme

International Workshop on Reactive Nitrogen Assessment in South Asia

February 26-27, 2016

Organized by ING-SCON and

South Asia Nitrogen Centre, New Delhi

Venue: Committee Room No. 1, NAAS, NASC Complex, New Delhi

Programme/Topic	**Speaker**	**Time**
Day 1		
1. Registration		0900-0930
2. Welcome and Introduction of the Participants	YP Abrol, ING	0930-0940
3. Reactive N assessment: Global Perspectives	N Raghuram, ING	0940-0950
4. Reactive N assessment: South Asian perspectives	TK Adhya, ING/SANC	0950-1000
5. Objectives of the workshop	H Pathak, IARI	1000-1010
6. Guest from MoES	N. Khare	1010-1020
7. Remarks from Chairman, INI	Mark Sutton, INI	1020-1035
8. Taking productivity to the next level – feeding south Asia	S. Ayyappan, President, Natl. Acad. Agril. Sci.	1040-1055
9. Vote of thanks	MK Tiwari, ING	1055-1100
Coffee/Tea		1100-1130
I. Reactive N footprints in south Asia: Chair – AK Sikka, DDG (NRM), ICAR		**1130-1330**
10. Setting the agenda – Reactive N	A.K. Sikka	1130-1140
11. Reactive N in soil-crop-environment in India	B.S. Dwivedi, IARI	1140-1155
12. Reactive N in soil-crop-environment in Bangladesh	J.C. Biswas, B'desh	1155-1210
13. Reactive N in soil-crop-environment in Nepal	K.R. Dahal, Nepal	1210-1225
14. Reactive N in soil-crop-environment in Pakistan	M. Yaseen, Pakistan	1225-1240
15. Reactive N in soil-crop-environment in Sri Lanka	S. Nissanka, Sri Lanka	1240-1255
16. Reactive N in soil-crop-environment in Maldives	M. Mustafa, Maldives	1255-1310
17. Discussion and comments	All participants	1310-1330
Lunch		**1330-1430**
II. N flows in different sectors: Indian and South Asian scenario: Chair- Mark Sutton, Chair, International Nitrogen Initiative		**1430-1700**
18. Fisheries and aquaculture	K. Vass to lead	1430-1445
19. Livestock and poultry	Madhu Mohini to lead	1445-1500
20. Reactive N, forestry and biodiversity loss	Asha Ram to lead	1500-1515
21. Energy, Industry, Transport in south Asia	C Sharma, NPL to lead	1515-1530
22. Health sector and reactive N – issues for south Asia	Bhola Gurjar to lead	1530-1545
21. N flow in rural and urban landscapes in south Asia	G. Beig to lead	1545-1600
Coffee/Tea		1600-1615
22. N-flow from Grasslands	S. Mahanta to lead	1615-1630
23. Discussion and comments from the Chair	Chair / all participants	1630-1700
Day 2		
III. N Processes in the biosphere – South Asia: Chair: Dr. Jyotish Biswas, Bangladesh		**09.30-1115**
24. Geographic variation of N flows	D.N. Benbi to lead	0930-0945
25. Coastal ecosystems and Mangroves	A.L. Ramanathan to lead	0945-1000

26. Oceanic Ecosystem	R. Ramesh to lead	1000-1015
27. Atmospheric deposition of Nr	U. Kulshrestha to lead	1015-1030
28. N and air quality	G Beig to lead	1030-1045
23. N and soil quality	Ranjan Bhattacharya to lead	1045-1100
24. Discussion and comments from the Chair	Chair / all participants	1100-1115
Coffee/Tea		**1115-1130**
IV. N policies and challenges for south Asia: Chair- Y.P. Abrol, President ING		
25. Reactive N – Policies and governance	Mark Sutton, INI	1130-1145
26. National Policies in the context of Nitrogen, pollution and Climate change	H. Pathak, IARI	1145-1200
27. Integration of N science and policies – Industry view	RK Tewatia, FAI	1200-1215
28. N in Indian and south Asian policies-future challenges	M.K. Tiwari, ING	1215-1230
29. Summary for policy makers	YP Abrol/TK Adhya, ING	1200-1215
30. General Discussion		1230-1300
Discussion, Synthesis and Recommendation	TK Adhya/H Pathak, ING All participants form South Asian countries	1300-1325
Vote of thanks	Aarti Bhatia, ING	1325-1330
Lunch		**1330-1430**
Departure		

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INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 17c (Activity 3.1c)

LATIN AMERICA Demonstration

INPE

CCST

Ciência para sustentabilidade

Summary

The complex landscape and farming practices of the La Plata Basin (LPB) result in a heterogeneous pattern of land use and thus an uneven distribution of nitrogen (N) use and pollution. A high proportion of agricultural production is devoted to commodities, namely soybeans, maize, wheat, sugarcane (bioethanol) and cattle, in an area stretching from the Cerrado and Atlantic forest areas in Brazil, to the pampas in Argentina and Paraguay, the flooded and rich soils in Bolivian Chaco, and the Pantanal region in Brazil and Bolivia (which includes the southern edge part of the Amazon biome). Given the importance of this region to the international food market, there is constant pressure to increase agricultural activities – both via intensification (increased use of inputs) and extensification (increased conversion of non-agricultural land, such as forest land, to agricultural production). Consequently, better understanding the drivers of land-use change and the adoption of agricultural best management practices is critical to developing a pathway for the sustainable transformation of the agricultural sector in this region. With this in mind, the impacts of too much or too little N in Latin America, and the LPB in particular, are important areas for future research and are the focus of this demonstration project. Our proposal outlines efforts to synthetize the latest scientific knowledge on regional N dynamics and include these dynamics in models simulating land-water interactions.

This project will collaborate with the **Comité Intergubernamental Coordinador de los Países de la Cuenca del Plata (CIC)**, which was established by the five countries within the LPB and has obtained support from the Global Environment Facility, UNEP and OEA.

Universities, research Institutes and agriculture producers will collaborate to develop this proposal. Partners include: the Brazilian Ministry of Science, Technology and Innovation (MCTI), the University of Sao Paulo, the University of Brasiia, the University of Buenos Aires, The InterAmerican Institute for Global Change Research, Centro de Solos e Recursos Ambientais - Instituto Agronômico; Agro-Pastoril Paschoal Campanelli S/A;

Expected outcomes from this cooperation include an estimate and mapping of nitrogen flow in this critical region for agricultural production and conservation of important water systems and unique ecosystems. The flow of nitrogen will match the metrics adopted in other components of the project looking to “too much and too little nitrogen”. The map will provide decision makers an overview of major constrains and critical flows, considering food (cereals and beef) production, water and air pollution and energy footprint – from fertilizer production needed to supply demand to bioenergy from soybean and sugar cane.

Contents

Abbreviations

CCST – Centro de Ciência do Sistema Terrestre

INPE – Instituto Nacional de Pesquisas Espaciais

CIC - Intergovernmental Coordinating Committee for the La Plata Basin Countries

LA – Latin America

LBP – La Plata River Basin

SP – State of Sao Paulo, Brazil

CIC - *Comité Intergubernamental Coordinador de los Países de la Cuenca del Plata* (Intergovernmental Coordinator Committee of the La Plata Basin Countries).

USP – University of Sao Paulo (Universidade de São Paulo)

UNESP – Sao Paulo State University (Universidade Estadual Paulista

UnB – Brasilia University (Universidade de Brasília)

UBA – University of Buenos Aires (Universidad de Buenos Aires)

IAC – Instituto Agronomico de Campinas (Campinas Agronomic Institute)

EMBRAPA - Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária)

IAI - Inter American Institute for Global Change Research

IGBP – International Biosphere-Geosphere Programme

GLP – Global Land Project

1 Introduction to the LATIN AMERICA Demonstration in 'Towards INMS'

1.1 Background and Context

1.1.1 Regional Problem

The La Plata Basin is one of the most developed regions in Latin America (LA), with socioeconomic indicators at levels similar to several highly industrialized economies. The basin extends over 3.1 million km^2, covering the Paraná, Paraguay and Uruguay river systems, important parts of Argentina, Bolivia, Brazil and Uruguay, and the entire territory of Paraguay (Figure A17c1). The region is an important engine of GDP growth for the countries in the basin, with high levels of industrial and agricultural development. Despite the importance of agricultural activities in the region, approximately 80% of the population live in urban areas.

Nevertheless, the strong economic performance this region has witnessed is accompanied by a number of environmental issues, with several a direct result of N losses. For example, the lack of infrastructure in several of the region's large cities have led to the release of untreated sewage into water bodies, negatively impacting water quality, biodiversity and human health, while generating additional water treatment costs. The pressures of agricultural, industrial and urban development have led to the deforestation of the Atlantic Forest to less than 15% of its original area, and much of the newly created agricultural land is subject to inefficient N use practices, which lead to significant N losses. Population growth and agricultural expansion have also contributed to a variety of other environmental problems, from soil erosion and water pollution, to the loss of wildlife habitats and climate change.

1.1.2 Monitoring and Evaluating

Efforts to address environmental issues could potentially be aided by the existence of a free trade bloc (MERCOSUR), which currently operates in four countries in the LPB – Argentina, Brazil, Uruguay, and Paraguay. Part of MERCOSUR's work program is to enhance scientific collaboration among universities and research institutes in the region, which provides an important basis to study regional environmental problems such as N pollution. N use and pollution vary widely across the LPB, from high levels of N use for commodity crops (such as corn and sugar cane) and BNF for crops such as soybean and other legumes, to low (and often insufficient) levels of N use by many smallholder farmers (see Table A17c1 for levels of fertiliser consumption and Figure A17c1 for N application rates to cereals across the region).

Table A17c1: *Fertilizer consumption (not only nitrogen) in the La Plata Basin and other places in South America. Source: IBGE, 2015 and IBRD, 2013.*

Fetilizer consumption in La Plata Basin (kg/ha*)	
Brazil - South	166.93
Brazil - Midwest	183.62
Brazil - Southeast	197.25
Paraguay	96.90
Uruguay	163.20
Argentina - North	34.73
Bolivia	9.70
Other Places in SA	
Brazil - North	115.08
Brazil - Northeast	112.17
Chile	595.83
Ecuador	229.10
Peru	105.00
Colombia	648.60
Venezuela	179.80
Guyana	44.60
Suriname	97.20

*kilograms per hectare of arable land

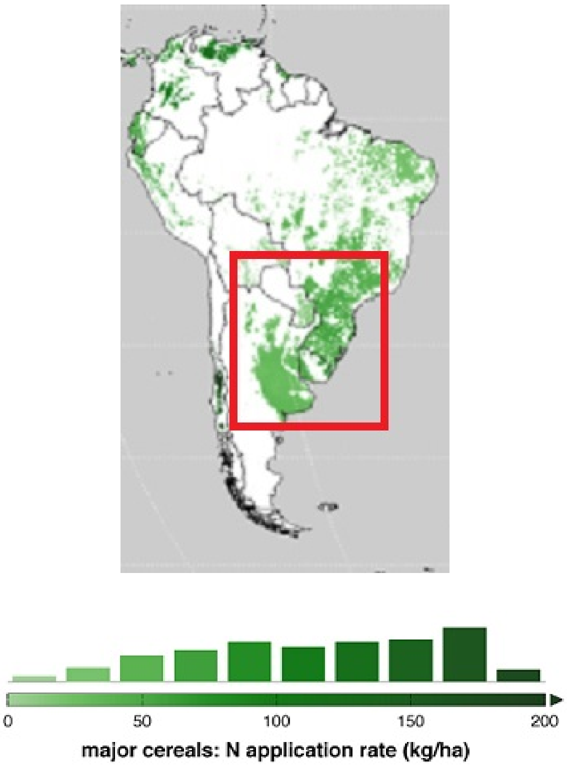


Figure A17c1: *N application rates in Latin America, with the La Plata Basin highlighted in red (adapted from Mueller et al. 2014)*

1.1.3 Result of the interventions at both national and regional levels

Implementation of INMS will help us to synthesize the latest scientific knowledge on regional N dynamics and integrate these dynamics into models simulating land-water interactions. This integrative, interdisciplinary analysis will aim to (i) quantify the major N sources and flows to and from the region, (ii) develop agricultural N use scenarios; (iii) synthesize the major ecosystem impacts from N pollution; (iv) improve land use management practices in order to increase N use efficiency within the region. With this, we expect a decrease in atmospheric N emissions, N loading waste water discharge and mitigation of N impacts on aquatic ecosystems.

1.1.4 Contributions to the INMS understanding/process

Considering the diversity and importance of agricultural activities in this region this proposal aims to better understand the drivers of land-use change and the uptake of agricultural best management practices in order to develop a transformation pathway that can lead the LPB towards a sustainable agricultural sector. We will address critical issues of land cover, agricultural production and connections to aquatic systems. In order to do so, we plan to include N dynamics in the modelling of land-use and land-water interactions – this is essential to provide a broader, more comprehensive understanding of the environmental problems this region faces, something which has yet to be done in this part of the world.

1.1.5 Relevance to national and regional policies

The INMS project will be very important for the development of agricultural, water and environmental policies, since current existing environment polices do not cover N issues. With these interventions, Latin American education and research institutes and policy makers will have the scientific evidence to develop relevant policies to ensure sustained development and better N management practices in LPB. In addition, in cooperation with other demonstration sites, the proposed project will provide recommendations to participating countries on ways to improve their national legislation and policy, as well as development of new transboundary agreements.

1.1.6 Relevance to global / regional agreements and conventions

There are no regional agreements and conventions specifically for N in LPB. However, prior to the 1960s, some relevant agreements dealing with water use in the basin were in existence. In 1969, the five countries signed the La Plata Basin Treaty creating the CIC (Intergovernmental Coordination Committee) responsible for developing activities of common interest in the Basin. After this treaty, several other treaties were signed by two or three countries, showing the weaknesses in the 1969 agreement. In 1973, Brazil and Paraguay signed the Itaipú treaty which created “Itaipú Binacional”, the entity responsible for the creation of the Itaipú dam and its energy generation. This treaty generated several conflicts with Argentina, but they were finally resolved in 1979 with the Three Party Corpus and Itaipú Treaty. This project is an opportunity to implement a broader agreement considering not only water but also nutrient use, biodiversity conservation and air pollution which are directly and indirectly related to N_r issue.

1.2 Environmental threats, root causes and barrier analysis

Over 100 million people live in the LPB, however in comparison to the Amazon Basin, little attention is received regarding environmental problems. Major developments are planned for the LPB, with policies aiming for integration, expansion of industries such as steelworks and mining, also biofuels and grain monoculture projects. Consequences from these activities will not be restricted to specific countries, but pose transboundary threats. These pressures will only increase while the countries continue to strive to increase the standard of living, for increasing populations, supported by growth and intensification of both the agricultural and industrial sectors.

The mosaic-like distribution of landscapes and societal arrangements result in a complex pattern of land use, with a strong presence of commodity production, such as soybeans, maize, wheat, sugarcane (bioethanol) and cattle production, in an area stretching from the Cerrado and Atlantic forest areas in Brazil, to the pampas in Argentina and Paraguay, the flooded and rich soils in Bolivian Chaco, and the Pantanal region in Brazil and Bolivia (which includes the southern edge part of the Amazon biome). Several of these commodities are intensive consumers of N fertilizer, which has led to low levels of N use efficiency (NUE) and significant N losses in parts of the LPB as a result. Water pollution is a major problem, both because of agricultural run-off but also due to untreated wastewater. A better quantitative understanding of these diffuse sources is a critical component of this proposal.

In areas where little fertiliser is used, this is often due to inefficient technical and financial rural assistance provided to small producers. Also, a large proportion of the nitrogen flux used in agriculture in the LPB is derived from Biological Nitrogen Fixation for soybean fields, which decreases the overall proportion of fertiliser use in comparison to other agricultural river basins across the globe. However, if climate change leads to a reduction in suitable areas for soybean cultivation in the LPB, the land-use change balance would shift towards increased areas of alternative crops, such as sugarcane. These crops would require direct addition of fertiliser, increasing the potential for nitrogen pollution.

Although no quantitative indicators on the extent of watershed transformation are available yet, some researches establish that over 35% of the total length of the Paraná River –about 2,570 km– has been altered by the construction of large reservoirs such as Ilha Solteira, Jupia and Porto Primavera (Brazil), Itaipú (Brazil-Paraguay) and Yacyretá (Argentina-Paraguay). This dramatic transformation of lotic environments into lentic ones in LPB can favour nitrogen accumulation and potential eutrophication has been observed in several reservoirs along the Paraná River in Brazil.

One important sectorial problem in LPB is the lack of interinstitutional coordination and even communication and exchange of information among the different agencies and countries that generates overlapping of management functions. Lack of coordination has favoured the development of intersectoral conflicts, especially among competitive uses like irrigation and hydropower generation. For example, in Argentina, there is an intersectoral conflict resulting from the competition for agricultural production and human consumption between Santa Fe and Santiago del Estero provinces, when the flow agreed between then does not get to Santa Fe. In Brazil, some conflicts among uses are observed in the Ibicuí River sub-basin (Uruguay River Basin), where the use of agrochemicals has altered the quality of surface spring waters used for supply to the human population, which generates growing costs in treatment of water for cities.

1.3 Institutional, sectoral and policy context

1.3.1 The main organisations (government and others) and private sector organisations (industry, farmers, etc) involved in N related issues

Several multilateral organizations and agreements are the source of policy-making activities in the LPB, namely MERCOSUR and the Comité Intergubernamental Coordinador de los Países de la Cuenca del Plata (CIC). The latter is the executive body of the La Plata Basin System (***Sistema de la Cuenca del Plata***), which integrates decision-making across Argentina, Brazil, Uruguay, and Paraguay on several important issues, including the environment. There are several private sector organizations associated with the agricultural sector that are important actors in the policy process: fertilizer and seed companies, machinery and technology companies (selling tractors, irrigation systems, etc), and farmer cooperatives and government technical assistance agencies. In addition, several universities and research institutes, such as USP, UnB, EMBRAPA, UBA, develop and disseminate technology and knowledge for agricultural production in this region. Nevertheless, despite this impressive network of government and non-governmental actors, smallholder farmers (and poorer farmers in general) have been underserved in this region, with poor infrastructure and low technology transfer hampering agricultural development.

1.3.2 What national policies are in-place / planned

There is not a common policy regulating land use in the region. In Brazil, the Forest Code recently approved by the Congress, guides farmers in how to balance the use of land for agricultural production versus environmental conservation. In addition there are no restrictions placed on fertiliser application rates or timing. The Brazilian Ministry of Agriculture, Livestock and Supply (MAPA) only supervises the production and trade of fertilizers, nothing further.

1.3.3 NGO and CSO activities

There are no NGO and CSOs working to address N-management specifically in LPB. However, there are around 45 NGOs working to improve biodiversity, water quality and sustainability. Most of the NGOs focus on biodiversity hotspot areas in the basin such as Pantanal and Cerrado. NGOs, such as WWF and ECOA, have worked in the Pantanal and the Upper Paraguay river basin, with local stakeholders on improving management of protected areas, the formation and strengthening of local organizations, institutional capacity building, environmental education programmes, and the promotion of sustainable productive activities like organic farming, ecotourism and community fisheries management. In Paraguay and Argentina, many NGOs aim to help the poorest families with severe problems regarding food supply, where the NGOs tend to strengthen the self-production of meals through community farms and food distribution among the poor population. Also, important NGOs, as Sobrevivencia (PY), CODES (PY), Proteger (AR) y Probioma (BO) help to conserve springs and regenerate degraded areas and encourage sustainable production by promoting the adoption of best practices for sustainable agricultural production. Although these NGOs do not address N problems currently, it is expected that the in the near future N issues may be included, as relevant information about N benefits/threats are addressed in the INMS demonstration site.

2 Baseline for the LATIN AMERICA Demonstration in ‘Towards INMS’

2.1 Baseline analysis

2.1.1 Previous work that is relevant to the work of this project

There is wide spatial disparity in the use of N fertilizers in the region, with the highest levels found in the more developed areas, and suboptimal amounts dominating in less developed areas. Moreover, there is spatial disparity in the sources of N inputs overall. For instance, in the south-eastern part of Brazil, N inputs from fertilizer and atmospheric deposition are relatively high compared to the Amazon region; while in the “Cerrado” biome atmospheric N deposition is driving an increase in the N budget (Filoso et al. 2006). Another concern is the long range transport of N compounds from biomass burning (particularly in July-September) in central Brazil and western Bolivia. (Longo et al. 2009). The Andean mountain range redirects the smoke plumes containing these chemicals (which are also precursors to other air pollutants such as tropospheric ozone) towards the eastern part of the Andes and down to the southern areas of South America. Studies by Artaxo et al. (2009) have shown significant deposition of nutrients and diverse organic compounds, but identifying the specific contributions of each compound, especially between inorganic and organic N compounds, is a challenge.

Another key aspect of N pollution in the LPB is its impact on water quality. Understanding the dynamics of N losses to coastal ecosystems is crucial to developing future eutrophication and hypoxia scenarios. A recent study using the Nutrient Export from Watersheds (NEWS) model analyzed future trends in nutrient export to the coastal waters of South America (van der Struijk and Kroeze 2010). However, the authors pointed out that their analysis is limited due to the lack of data. Improving our understanding of how N pollution in regional watersheds contributes to N loading in coastal areas will enhance our capability for developing appropriate mitigation strategies. In general, pastures dominate agricultural land in Latin America. Soybean and maize occupy about 50% of the arable land in the LBP, with sugar cane also an important crop. Wheat, rice, coffee and citrus are also important in the region. The crops used in the day to day food supply, such as vegetables, cassava, and potatoes are generally produced by smallholders using less nitrogen. The productivity of all major crops in the region has increased following the adoption of improved ‘tropical agriculture’ best management techniques, e.g. no till, and the increased of use of nitrogen, which has risen tenfold over the past 50 years (from an average of 5 to 50 kg/ha).

The geographic extent and timing of anthropogenic enhancement of N inputs in both terrestrial and aquatic ecosystems are poorly constrained, and the impacts of these changes have not been comprehensively assessed (Martinelli et al 2006). Although studies have assessed ways to increase the N use efficiency of crops and decrease N losses in South American countries (García et al 2009), proven methods for mitigating N pollution from agriculture have not been widely applied (Austin et al 2013). A first-approximation study in LPB in 2012 assessed the main aspects of the nitrogen cycle and highlighted agricultural activities as playing an important role in adding reactive nitrogen to the basin. Most of the current anthropogenic nitrogen load is related to BNF in soybean fields which actually decreases the proportion of fertiliser use compared with other agricultural river basins in the world (Watanabe et al. 2012). However, studies have shown that future scenarios may lead to increasing quantities of fertiliser use, especially in the case that climate change reduces suitable areas for soybean cultivation, leading to the planting of fertilised crops such as sugarcane. Also, recent studies in Brazil showed that although primary sewage treatment alleviates the input of labile organic matter to rivers, the N concentration remains practically unchanged, revealing that this type of sewage treatment is not sufficient to decrease N inputs to LPB rivers (Daniel et al 2002, Bonini 2014).

2.1.2 GEF actions

Several research projects in the region deserve mention. This includes the GEF project (Sustainable Management of the Water Resources of the La Plata Basin with Respect to the Effects of Climate Variability and Change) which focuses on improving water quality: "*strengthen the efforts of the governments of Argentina, Bolivia, Brasil, Paraguay and Uruguay to implement their shared vision for the environmentally and socially sustainable economic development of the la Plata Basin, specifically in the areas of the protection and integrated management of its water resources and adaptation to climatic change and variability" (http://iwlearn.net/iw-projects/2095)*. The project is co-ordinated by the CIC. Further relevant GEF actions are included in Table A17c2.

The existence of GEF's support for CIC has resulted in four converging actions in support of the La Plata Basin System aimed at strengthening the integrated management of its water resources:

- **ICC-ISARM Americas UNESCO/OAS-Cooperation by the Ministry of the Environment of Italy.** PDF-B funding by GEF acted as a catalyst to make the La Plata Basin and CIC a suitable environment in which to intensify the methodological experience in sustainable management of transboundary aquifers being implemented by the International Association of Hydrogeologists (IAH), with support from UNESCO, through the Internationally Shared (Transboundary) Aquifer Resources Management Program (ISARM) and in particular in its proposal for the American Hemisphere: ISARM Americas/UNESCO/OEA.
- **Plata-Rhine Twin Basin.** In 2004, CIC signed a Twinning Agreement with the International Commission for the Protection of the Rhine (ICPR) to exchange the experience and knowledge acquired by both Commissions.
- **Participation of CIC and the La Plata Basin in UNESCO's WWAP Program.** Given the global importance assigned to the subject of "Water Resources" in the world, the background of the La Plata Basin Treaty, and the preparation of the Framework Program for the Basin supported by GEF, the World Water Assessment Program agreed with CIC to include a section in its next report highlighting the situation of water in the world and the integrated management of water resources in the La Plata Basin.
- **CIC - OACT Agreement.** In September 2004 the General Secretariat of the Intergovernmental Coordinating Committee for the la Plata Basin Countries (CIC) and the Organization of the Amazon Cooperation Treaty (OACT) signed a Letter of Understanding in Brasilia, Brazil, on exchanging experiences on the integrated management processes of both basins and in particular on the processes for preparing and implementing the GEF Projects in International Waters (transboundary), involving the two Commissions that cover more than three quarters of the surface waters flowing through South America, its two large basins and all the countries of the continent of South America, with the exception of Chile.

Table A17c2: *Table of GEF actions in the region.*

GEF ID	Project Name	Region	Completion Date	Linkage with this project
4860	Mainstreaming Biodiversity Conservation and Sustainable Land Management into Production Practices in all Bioregions and Biomes	Paraguay	CEO Endorsed	Provides information on land management within Paraguay
5465	Updating the National Biodiversity Strategy and Developing the Action Plan to Support the Implementation of the CBD 2011-2020 Strategic Plan	Paraguay	CEO Approved	Provides information on biodiversity and environmental policy within Paraguay
5470	Improved Convention Coordination for Sustainable Growth in Uruguay (ECCOSUR)	Uruguay	PIF Approved	Provides information on instruments for increased global environmental benefits and sustainable growth

2.1.3 Other donors

One project that address Nr issues is the LA Demonstration collaboration with the Nnet Project (**Nitrogen Cycling In Latin America: Drivers, Impacts And Vulnerabilities)** supported by the National Science Foundation (NSF) through the Inter American Institute for Global Change Research (IAI). This project consists of working groups focusing on various aspects of the N balance in the region – from field measurements, to model experiments, to reviews of existing work The goal of this project is to develop an integrated view of nitrogen management via : (1) Dissemination of knowledge about the causes and consequences of change in the regional N cycle and the implications for the environment and human health. (2) Develop guidelines for policymakers and the general public to facilitate decision-making on N management issues in the region.

With all this in mind, our project aims to synthetize the latest scientific knowledge on regional N dynamics and integrate these dynamics into models simulating land-water interactions. This integrative, interdisciplinary analysis will aim to (i) quantify the major N sources and flows to and from the region, (ii) develop agricultural N use scenarios ; (iii) synthesize the major ecosystem impacts from N pollution; Analysis will be geo-referenced at the finest possible scale, using modelling and data framework tools (e.g., TERRA-ME).

2.2 Gaps

Major gaps in N dynamics in the LPB include: (i) spatial distribution of the N budget; (ii) impact of too much N in aquatic systems; (iii) impact of too little N in smallholder agricultural production; (iv) lack of transboundary policy on N flows; (v) communication of the importance of N to the general public. These issues can then be addressed in the demonstration activity through the following activities, (i) through data gathering on N flows and estimations of uncertainties (Tasks 3.1.1 to 3.1.3, see Section 3 for details at Task level). This information will help to address issue (ii) by providing background information to identify and agree key threats (Tasks 3.1.4 & 3.1.5) and report on N performance indicators (Task 3.1.6). Reviewing the available current options for better N management, in tandem with demonstrating benefits of a joined up approach, within Component 3 (Tasks 3.1.7 & 3.1.8) and through project level activities in Component 4, headway with issue (iv) can hopefully be achieved. Finally, communication to the public about local success stories, and gaining information on barriers to change (Task 3.1.8) along with project level engagement products planned in Component 4, which can be adapted for best use in our region, will address (v).

2.3 Stakeholder analysis

The main producers of N fertilizers in Brazil can be identified through an analysis of sector organizations and cooperatives such as ANDA (***Associação Nacional para Difusão de Adubos***), CONAB (***Companhia Nacional de Abastecimento***), as well as via contact with representatives in the Ministry of Agriculture.

The LPB has powerful stakeholders in the bioenergy (specifically sugar cane) and beef sectors. Soybeans are another important commodity represented by several important national and multinational stakeholders.

Civil society is weakly represented. However, where it is present, it frequently focuses on water quality and availability. Another important area of attention is family agriculture and smallholders. In Brazil, the National Bank has responded to this focus by providing significant investments to family agriculture and low carbon agriculture initiatives. However, these are national initiatives, and not transboundary ones that could be applied to the entire LPB. A more comprehensive study of regional stakeholders is being developed by the Nnet project. The results emerging from this project will be used in the initial period of the regional demonstration to engage further with all available stakeholders. This should provide a good basis for membership of the Stakeholder Advisory Group, which will be important for reviewing and advising on the activities of the demonstration.

3 Project Description for the LATIN AMERICA Demonstration in INMS

3.1 Strategy

The work plan described in this Appendix forms part of the overall execution of INMS Component 3 on the Regional Demonstration of the Full Nitrogen Approach. The rationale for this broader approach is described in Appendix 17. The development of a common strategy to all the Regional Demonstrations in INMS is an iterative process and has already benefited from three workshops connected with the PPG Phase. This strategy aims to a) provide sufficient common approach to allow comparability between the different regional demonstrations, especially when synthesizing and applying the results (Activities 3.2-3.4; Activities 2.2-2.4), b) provide sufficient scope to allow regional priorities to be addressed according to the different regional needs.

Project Objective: To improve the understanding of the global/region N cycle and investigate / test practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems

Outcome 3.1: GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient

N_r, ensuring that any negative effects are minimised [This outcome is addressed through Component 3 of the project]

Output 3.1: A demonstration activity in Latin America which delivers conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing Case 2: Challenges and opportunities for developing areas with insufficient reactive nitrogen.

The demonstration activities are encompassed within **Activity 3.1**: Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle. Activity 3.1 has several Tasks (see also Figure A17c2). Interim Task Outputs have also been devised for all demonstration activities (see Figure A17c3).

- **Task 3.1.1 & 3.1.2:** Examination of N flows by source sector & loss pathway; inc improving access to data
- **Task 3.1.3:** Identifying & quantifying major uncertainties and means to improve
- **Task 3.1.4 & 3.1.5:** Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA
- **Task 3.1.6:** Description in relation to N performance indicators, in co-operation with global analysis
- **Task 3.1.7:** Review of available options for mitigation/better N management, co-benefits/trade-offs
- **Task 3.1.8:** Profiling success stories, barriers to change, and demonstration of N joined up approach
- **Task 3.1.9:** Contribution to scenario development in cooperation with global analysis.

3.1.1 Activity 3.1: Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.

Output: Conclusions refining approaches to regional assessments and improving understanding of regional N cycle.

The elements of this activity for the LPB demonstration site are summarized visually in Figure A17c2. These include, examination of N flows by sources sector and loss pathway, providing the identification and quantification of major uncertainties and identifying key threats and benefits priorities with policy stakeholders; description in relation to N performance; review of available options for better N management; profiling success stories; and finally contributing to scenario development in cooperation with global analysis. These elements will provide a better understanding of the N cycle in a developing area with areas with excess and insufficient N where the impacts of land use and land cover changes, urbanization and climate extremes in the nitrogen cycle, are issues still demanding deeper understanding.

Particular attention needs to be given to the heterogeneity of the economic activities in the region that determines a variety of N sources and sinks. The economies of Argentina, Brazil and Uruguay have relatively more significant production of industrial goods and services, while those of Bolivia and Paraguay remain more broadly based on agricultural production. As described above, LPB refers to a region with a developing economy, where issues related to the use of nitrogen, social economy, food production and environmental policies are not unified in the region, but similar challenges and opportunities can be identified among these countries. This makes the project of high interest for the environmental policy arena in the region.

In this demonstration site, the main focus involves understanding better the limitations to action, what are the key drivers for action and what are the regional priorities to overcome barriers to better nitrogen management. However, a large part of the activity needs to be dedicated to improving availability and access to data since effective cooperation between research groups in different countries, governmental institutes and agencies is relatively new, compared to developed regions in the world.

The output of this activity will consist of an improved understanding of the regional N cycle that will help develop regional and global policy framing for nitrogen (Component 2) contributing for establishment of scenarios for future options in cooperation with the global analysis, but informed by the regional evidence (Component 3). The outcomes from the activities will also feed in to inform developments in Component 2 in, A2.2 – global consolidated assessment & A2.3 - methods for better N management.

3.1.2 Linkages with GEF and non-GEF interventions

Partners in the South America who are interested to contribute to this activity in LPB include: Comité Intergubernamental Coordinador de los Países de la Cuenca del Plata (CIC); The Brazilian Ministry of Science, Technology and Innovation (MCTI); The University of Sao Paulo, the University of Brasiia; The University of Buenos Aires; The Inter American Institute for Global Change Research; Centro de Solos e Recursos Ambientais - Instituto Agronômico; Agro-Pastoril Paschoal Campanelli S/A

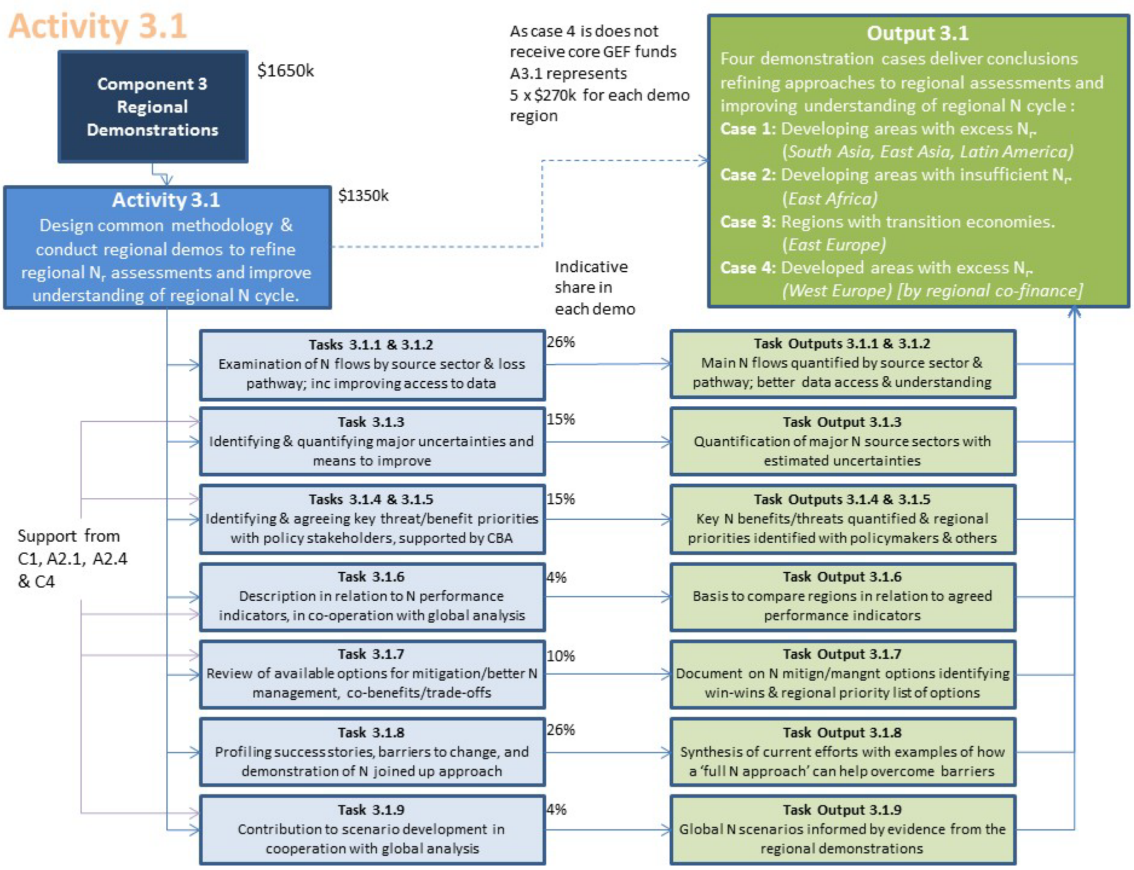


Figure A17c2: Structure of Activity 3.1, to Task level.

3.2 Project Sub-components and activities

3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; including improving access to data

Task Output 3.1.1 & 3.1.2: Main N flows quantified by source sector & pathway; better data access & understanding

To reach the main output for this demonstration activity, an appropriate effort needs to be focused on Tasks 3.1.1 and 3.1.2. This task will link activities with the Inter-American Institute for Global Change Research (IAI) (http://www.iai.int/?page_id=1054), an "intergovernmental instrument by which scientists and decision makers of countries throughout the Americas might jointly address the critical issues associated with global change in the region." The Nnet project funded by IAI has developed in the last two yeas an integrated network to approach university and research institutes for the purpose of creating a complete database addressing N stocks, flows and pathways in Latin America. Also, the demonstration site will have support of the Comité Intergubernamental Coordinador de los Países de la Cuenca del Plata (CIC), and the Programa Marco para a Gestão Sustentável dos Recursos Hídricos da Bacia do Prata, Considerando os efeitos decorrentes da variabilidade e Mudanças Climáticas (http://projetoscic.org/a-bacia-do-prata).

This component will include environmental gradients (precipitation and altitude) as well as gradients of land-use intensity (natural, rural and urban areas) and the processes will be analysed in terrestrial and aquatic ecosystems. The data will be preferentially selected from long-term study sites where additional information on biogeochemical cycles is available. Co-operation between universities, science groups, governmental institutes, NGOs and industries (e.g fertilizer industry, farming organizations, water management organizations) will be intensified to identify gaps of data and limitation for quantifying N flows. The challenge in this task will be to agree with the different sectors and countries a suitable balance between accessibility and centralization of the existing distributed data sources since Latin America has no sharing and storing agreement for scientific data.

This task will gather the necessary information to define and agree upon the important N source sectors and pathways for LPB (Task 3.1.3).

Task 3.1.3: Identifying & quantifying major uncertainties and means to improve

Task Output: Quantification of major N sources sectors with estimated uncertainties

Human interference on the nitrogen cycle in LPB is related to a growing economy and its population that demands food, raw material and energy. Although cities modify the environment through waste production and fossil fuel burning, the major impact to the nitrogen cycle takes place in agricultural and non-degraded pasture areas which sustain city's demand for goods and services through biological nitrogen fixation and use of manure and chemical fertilisers (the Haber Bosch process). Therefore, to calculate the nitrogen input from fertiliser to croplands into the LPB, it is necessary to estimate the values of several cropland areas in the basin. Usually, databases provide values of hectares cultivated for a given crop considering political borders instead of geographical features.

More detailed information about the land use in LPB will improve our knowledge about N sources in the region and, consequently, the success of management practices, mitigation and adaptation.

Nitrogen outputs are also affected by human activities such as the trade of farm commodities (with high protein content such as soybean and meat) to external markets and the riverine export of nitrogen in which water carries a fraction of the anthropogenic input of nitrogen to freshwater systems and to the Atlantic Ocean. All these inputs and outputs need to be assessed with the purpose of investigating some aspects and uncertainties of the nitrogen cycle in this river basin.

Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA

Task Output: key N benefits/threats quantified & regional priorities identified with policymakers & others

This task is an important one for this demonstration site, as it will provide a key vehicle to present and systematize the main priorities for economy and environment protection in LPB. Based on available literature, the initial process will consist of determining the regional N threats and benefits considering the heterogeneity of the activities in the LPB.

The output from this task will contribute to developing a report on quantified threats and regional needs identified with policymakers and others. Workshops with stakeholders will encourage agreement on the priorities for the five countries involved based on their economic activities, and the outputs can provide information to define a list of mitigation and management options for each situation (Task 3.1.7).

Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis

Task Output: Basis to compare regions in relation to agreed performance indicators

This task will be developed in association with the Component 3 Management Group and other demonstration site groups. Based on the results of the previous Tasks of Activity 3.1, key performance indicators will be quantified to evaluate the differences between regions. The challenge of this task for LPB will be defining the target to be reached in the region as the involved countries have different economic demands and policies. The output from this task for LPB will contribute to a final report on agreed performance indicators comparing all five demonstration sites in co-operation with global analysis.

Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs

Task Output: Document on N mitigation/management options identifying win-wins & regional priority list of options

The initial procedure for this task will be to conduct an initial review of mitigation and N management options for this demonstration site in collaboration with Activity 2.4 from Component 2. After the definition of regional priorities in Task 3.1.5, a consultation document will be developed considering mitigation and management options, identifying potential win-wins and a priority list of options. This Task will also be supported by the analysis of existing success stories of management in the demonstration site that will be conducted on Task 3.1.8. From a synthesis of the consultant information, a document containing the best practice options will be developed for submission to the Component 3 Management Group and Project Management Board.

Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach

Task Output: Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers

The starting point here is to gather the existing published sources on good practice guidance in LPB and make a review of existing policies for different regions and countries, examining what policies they have in place as these link to the nitrogen cycle. Workshops will bring together all the Demonstration Management Boards and Component Leaders to share current experience on 'full N approaches' in a regional and global context.

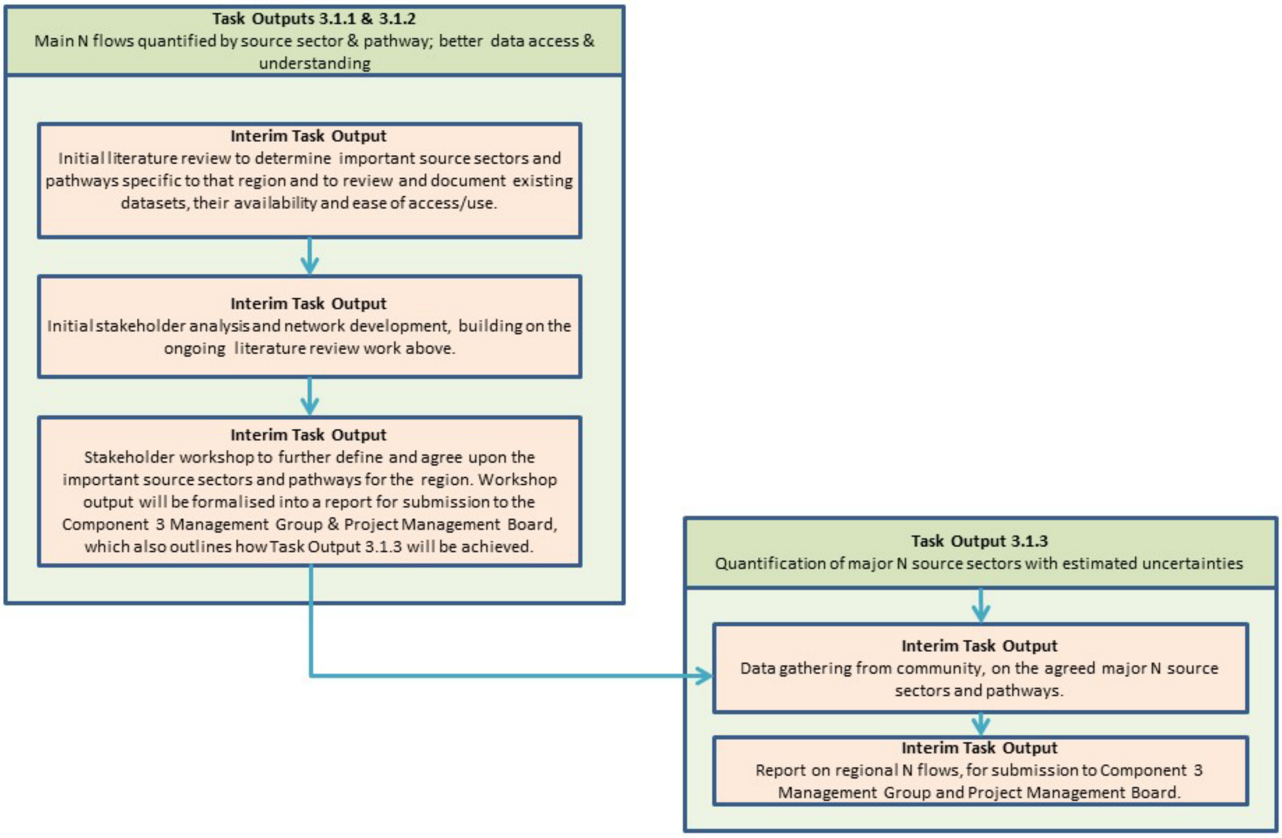
A five year project, "Sustainable Management of the Water Resources of the La Plata Basin with Respect to the Effects of Climate Variability and Change" implemented by UNEP and financed by GEF, had the long-term objective to strengthen transboundary cooperation among the governments of Argentina, Bolivia, Brazil, Paraguay, and Uruguay to implement their shared vision for the environmentally and socially sustainable economic development of the La Plata Basin. This work encountered several barriers to change in achieving its objectives, resulting from differences in political, legal and financial structures within the different countries. These barriers must also be addressed in the INMS project to implement a durable discussion about the N cycle among stakeholders from the five countries and ensure progress at a technical level.

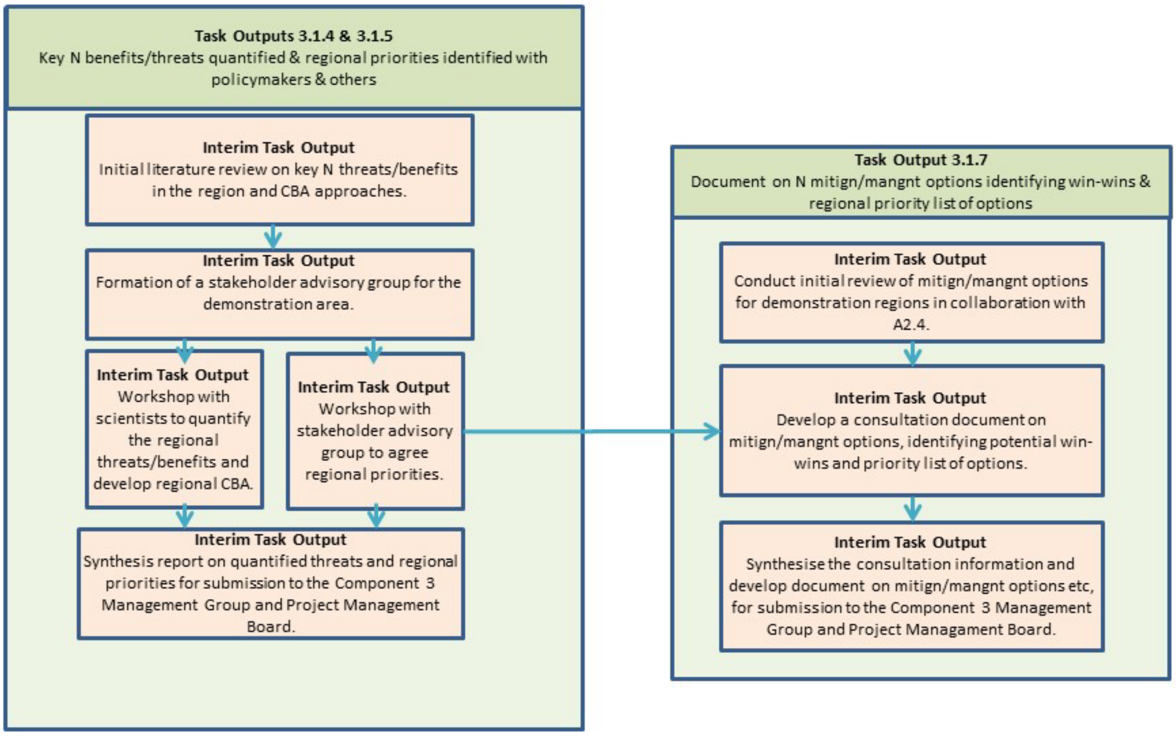
The output will consist of a synthetic guidance document with examples of a 'full N approach' and how it can help overcome barriers. Also, an examination of barriers to change, involving economic and cultural factors, food system and others, in collaboration with Activity 1.6, will contribute to understand the barriers at all levels of society (A1.6 Output).

Task 3.1.9: Contribution to scenario development in cooperation with global analysis

Task Output: Global N scenarios informed by evidence from the regional demonstrations.

This task will serve to bring together key information about the LPB (existing policies, current N storylines and barriers to change etc.) in order to elaborate a document with broad storylines to frame possible futures in collaboration with Component 2 (Activity 2.4). The starting point will be to review and document regional scenarios considering the differences between the five involved countries, examining what policies there are in place and which strategies could be implemented to improve N management at local, regional and global levels. These scenarios will be based on agreed priorities with regional stakeholders and will collaborate and support the work of Activity 2.4.


Task Outputs 3.1.1 & 3.1.2
Main N flows quantified by source sector & pathway; better data access & understanding
Interim Task Output
Initial literature review to determine important source sectors and pathways specific to that region and to review and document existing datasets, their availability and ease of access/use.
Interim Task Output
Initial stakeholder analysis and network development, building on the ongoing literature review work above.
Interim Task Output
Stakeholder workshop to further define and agree upon the important source sectors and pathways for the region. Workshop output will be formalised into a report for submission to the Component 3 Management Group & Project Management Board, which also outlines how Task Output 3.1.3 will be achieved.
Task Output 3.1.3
Quantification of major N source sectors with estimated uncertainties
Interim Task Output
Data gathering from community, on the agreed major N source sectors and pathways.
Interim Task Output
Report on regional N flows, for submission to Component 3 Management Group and Project Management Board.


Task Outputs 3.1.4 & 3.1.5
Key N benefits/threats quantified & regional priorities identified with policymakers & others
Interim Task Output
Initial literature review on key N threats/benefits in the region and CBA approaches.
Interim Task Output
Formation of a stakeholder advisory group for the demonstration area.
Interim Task Output
Workshop with scientists to quantify the regional threats/benefits and develop regional CBA.
Interim Task Output
Workshop with stakeholder advisory group to agree regional priorities.
Interim Task Output
Synthesis report on quantified threats and regional priorities for submission to the Component 3 Management Group and Project Management Board.
Task Output 3.1.7
Document on N mitign/mangnt options identifying win-wins & regional priority list of options
Interim Task Output
Conduct initial review of mitign/mangnt options for demonstration regions in collaboration with A2.4.
Interim Task Output
Develop a consultation document on mitign/mangnt options, identifying potential win-wins and priority list of options.
Interim Task Output
Synthesise the consultation information and develop document on mitign/mangnt options etc, for submission to the Component 3 Management Group and Project Managament Board.

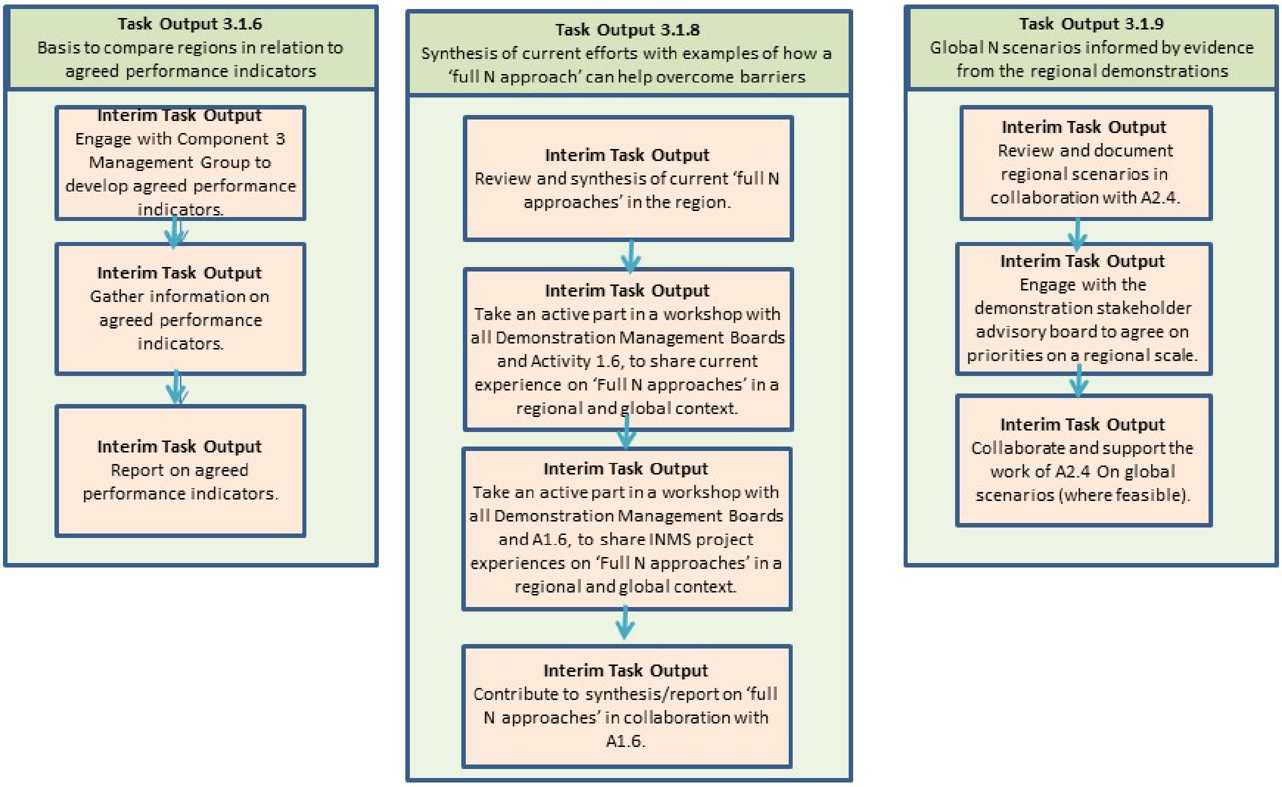


Figure A17c3: Structure of Task Outputs, Tasks 3.1.1-3.1.9

3.3 Budget and co-financing

3.3.1 Budget

The budget below reflects the need to support the following activities in the demonstration activity, a) establishing a regional coordination team (regional coordinator, principle investigators and project officer(s), the latter at post-doctoral level), b) significant travel budget to allow meetings and team working, c) a smaller budget for necessary bought in services, d) engagement with leading scientists from other world regions to support sharing of expertise and tools. In order to maximize the support to the demonstration regions, it is proposed to cover d) under other components of the project. In the case of Latin America, the proposed Regional Co-ordinator is a public employee and therefore is unable to receive a salary from the project. This means that their time will be provided as co-financing to the project. A budget breakdown is provided below, however it is intended that this budget be revisited at the start of the project, and re-submitted to the project management board and Project Partners Assembly, for agreement at the inception meeting.

Table A17c3: *Budget breakdown by cost type*

Cost Type	Cost per year (USD)	Cost for project [4 years] (USD)	Notes
Establishing and supporting a regional team			
Regional Co-ordinator	0	0	This will be covered fully by co-financing.
Project Officer 1 (post-doc level)	26,000	104,000	
Office and admin costs (including printing budget for dissemination materials)	1,000	4,000	
Total	***27,000***	***108,000***	
Support for meetings (including travel and venue budgets, preparing communications, reports and experiences)			
Travel & Subsistence Costs	20,000	80,000	
Venue and Catering Costs	12,250	49,000	
Preparing reports etc.	1,500	6,000	

Total	*33,750*	*135,000*	
Additional bought in Services (e.g. to supplement key datasets, additional necessary information etc)			
Total	*6,750*	*27,000*	
Total for Demonstration	**67,500**	**270,000**	

Table A17c4: *Budget breakdown by Task*

Task	Cost (USD)
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	70,200
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	40,500
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	40,500
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	10,800
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	27,000
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	70,200
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	10,800
Total	270,000

3.3.2 Co-financing

The table below provides information on co-financing by Task and partner. The demonstration will be co-ordinated by the Chair of the Latin American Regional Centre of INI, based at the Earth System Science Centre/National Institute For Space Research. However the work will be conducted in partnership with the following organisations:

- Comité Intergubernamental Coordinador de los Países de la Cuenca del Plata (CIC)
- The Brazilian Ministry of Science, Technology and Innovation (MCTI)
- The University of Sao Paulo, the University of Brasiia
- The University of Buenos Aires
- The Inter American Institute for Global Change Research
- Centro de Solos e Recursos Ambientais - Instituto Agronômico

- Agro-Pastoril Paschoal Campanelli S/A

A co-financing letter from the Earth System Science Centre/National Institute For Space Research can be found in Appendix 12, which serves to represent all organisations to be involved in the demo (i.e. the above). As the project progresses in partnership with these organisations (and others), it is anticipated that we will be able to report on the co-financing provided to the demonstration by them, increasing the overall level of co-financing support provided to the project listed at this stage.

Table A17c4: Co-financing budget, listed by Task and Partner

Task	Co-financing (USD)	Partner
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	150,000	Earth System Science Centre/National Institute For Space Research
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	50,000	Earth System Science Centre/National Institute For Space Research
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	50,000	Earth System Science Centre/National Institute For Space Research
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	50,000	Earth System Science Centre/National Institute For Space Research
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	100,000	Earth System Science Centre/National Institute For Space Research
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	50,000	Earth System Science Centre/National Institute For Space Research
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	50,000	Earth System Science Centre/National Institute For Space Research

3.4 Workplan

A work plan for the Tasks in this demonstration area is provided below. Please note that this is a provisional plan, which will be reviewed at the start of the project, for review and agreement by the Project Management Board and endorsement by the Project Partners Assembly.

Activity 3.1 Design common methodology & conduct Latin American demo to refine regional N_r assessments and improve understanding of regional N cycle.	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Tasks 3.1.1 & 3.1.2 Examination of N flows by source sector & loss pathway; inc improving access to data		M				M			W							
Task 3.1.3 Identifying & quantifying major uncertainties and means to improve																
Tasks 3.1.4 & 3.1.5 Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA		M							W							
Task 3.1.6 Description in relation to N performance indicators, in co-operation with global analysis									W			R				
Task 3.1.7 Review of available options for mitigation/better N management, co-benefits/trade-offs		M							W			R				
Task 3.1.8 Profiling success stories, barriers to change, and demonstration of N joined up approach									W			R				
Task 3.1.9 Contribution to scenario development in cooperation with global analysis		M				M						R				
Monitoring and Evaluation					R				R				R			R

3.5 Sustainability

During the activities of the demonstration, key linkages with universities, research institutes and stakeholders will be formed, promoting capacity building and training in activities such as nitrogen management, which can be further developed beyond the project. These activities can also be supported by the ongoing work of the Latin American Regional Centre of INI. In the area of policy, engagement with the La Plata Basin Countries Intergovernmental Committee should lead to long term activities in the region.

3.6 Replication

At its very heart, the plans for the regional demonstrations are designed to enable replication in other areas. During the Latin American demonstration, it will become apparent which regional areas will be best to replicate the INMS process of improving nitrogen management. Other regions that could benefit from the INMS approach and where the partners of this proposal have on going projects/activities are San Francisco river basin, Parnaíba river basin (Sao Paulo Science Funding Agency proposal) and Paraíba do Sul River basin (Waterfall Project; Sao Paulo Science Funding Agency projects).

3.7 Awareness raising, communications and dissemination

A regional communication strategy will be developed, linked to the activities within Component 4, where the global (project and geographic) strategy will be developed. Research network websites will be used where possible, such as Rede Clima in Brazil and policy briefings and bulletins will be developed for regional circulation. As well as support from the overall INMS project, support from both the Earth System Science Centre, of the National Institute for Space Research, in Brazil and through INI can be envisaged. Any opportunities for submitting results to journals as scientific publications will be explored, as this benefits not only the project, but the science area and the individuals involved in the project – thus aiding in the leverage of co-financing from their institutes for ongoing work.

3.8 Execution arrangements

The day-to-day running of the demonstration activity will be co-ordinated by the Regional Co-ordinator, in collaboration with a 'Demonstration Management Group' (DMG) (see Figure A17c4). A Stakeholder Advisory Group (SAG) will also be formed, to review and advise on the work. The DMG will be responsible for reporting to the Component 3 Management Group on their progress and the use of finances, as well as directly to the Project Management Board as necessary.

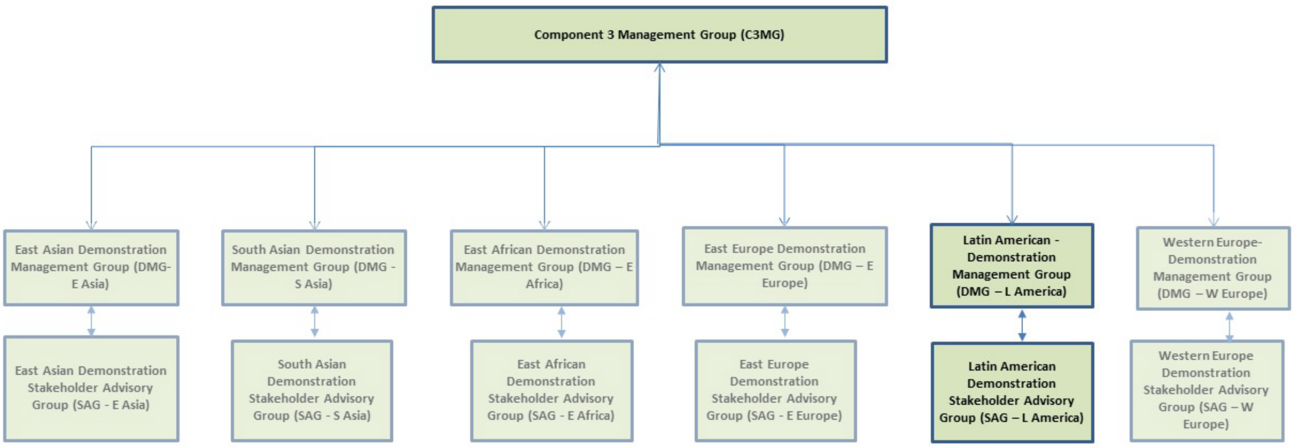


Figure A17c4: Structure of management and responsibility for Latin American demonstration activity.

4 Monitoring and Evaluation

4.1 Demonstration Project Results Framework

The present detailed log-frame (project results framework) covers aspects that are specific to the Latin America Regional Demonstration. It should be read in conjunction with the project results framework for Component 3 as a whole (see Appendix 17), which emphasizes common aspects between the different INMS demonstration regions.

	Objectively Verifiable Indicators			Sources of Verification	Assumptions
Outcomes, Outputs and Activities	Indicator	Baseline	Target		
Outcome 4: GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised	Project-level demonstration methodology guidelines adopted and published Requests for and application of demonstration area methodologies, tools and practice by external parties	Limited information from previous GEF interventions and partial N budget recently developed.	Project level methodology developed and agreed. Uptake of demonstration area methodology in other areas.	Workshop reports Contribution to synthesis documents	Active participation of the populations and policy makers in Latin America Availability of diversified expertise and technologies in Latin America
Output 3.1: A demonstration activity which delivers conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing: Case 2: Challenges and	Report on N sources and N flows for Latin America. Report on consensus on N priority sources, forms and impacts for Latin America.	Lack of joined up data on N sources and flows regionally. Lack of knowledge on how N sources and impacts fit together.	Quantified N flows, with uncertainty indication by end Year 3. Clearly identified priorities for N sources, forms and impacts by end Year 3	Reports, contrib'n to global synthesis (A2.2). Reports of science-stakeholder workshops.	

opportunities for developing areas with insufficient reactive nitrogen. (Note that some aspects are also relevant to Case 1: Challenges and opportunities for developing areas with excess reactive nitrogen)	Regional condition according to agreed N performance indicators. Information on priority N management and mitigation options. Information on successes and opportunities. Information on regional specificities for global scenarios	Lack of knowledge on how different N indicators relate, especially at regional level. Diversity of views and lack of consensus on the best methods to obtain N co-benefits. Variable progress, with limited attention to linking N co-benefits Existing global scenarios paying insufficient attention to regional conditions.	Statement of Latin American performance in using agreed N indicators by end Year 3. Draft 'Top 10' priority measures for improved N management for Latin America (end Year 2). Document for Latin America, showing how N approach can address barriers and share success stories (Year 4). Global scenarios informed by evidence from the Latin America Demonstration (Year 3).	Report and contribution to INMS publications. Report provided to A2.3 for incorporation in global comparison. Documents for Latin American demonstration. Report from A2.4 workshop.	

Annex 1: Terms of Reference for Partners / Key Consultants

Terms of Reference for the roles of Demonstration Project Co-ordinators and Project Officers along with potential consultants, is included in Appendix 11. The remit of these roles, along with decisions on the institutions and persons taking on these roles for each Demonstration Region, will be subject to endorsement by the Project Partners Assembly at the Inception meeting of the project.

Annex 2: Details about Demonstration Region

(Maps, additional information etc.)

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 17d (Activity 3.1d)

EAST AFRICA Demonstration

Summary

The project will be implemented in East Africa, one of the five demonstration regions. The countries involved include Burundi, Kenya, Rwanda, Tanzania, and Uganda. Most of the activities will be conducted in the Lake Victoria Catchment. The region is very relevant for Towards INMS as it consists of the too little and too much paradox. The N used for production is two little due to insufficient use of N inputs, whereas the eutrophication of Lake Victoria at selected sections has been related to high loading of nutrients mainly N and P. This is a consequence of unsustainable agricultural practices, deforestation, erosion, encroachment to marginal lands because of population pressure and low crop productivity on unit area and nutrient inputs from municipal wastewater.

Recent studies have shown that the nitrogen load into the Lake includes significant sources from municipal and industrial waste, atmospheric deposition, agriculture and natural sectors. The contribution of each source is not well understood and the available information is in some cases contradictory. There is a need to apply state-of-the-art techniques to improve the estimates. There is also almost a consensus that the current equation of nitrogen use efficiency applied in regions with sufficient application of N does not fit to the regions with too little N (East Africa). Selected scientists prefer the use of N agronomic efficiency that takes into consideration nutrient balance. There is a need to determine the best approach to assess the N use efficiency in Africa and the interventions to improve it. This project will build on lessons learned from previous and other ongoing initiatives. The audience and baseline analysis will identify the past and current initiatives with similar goal to maximize the effectiveness and efficiency.

Innovation platforms will be created to explore the best way of making the knowledge gained in the context of this initiative useful to the communities in and beyond the region. It is expected that good practices intended to improve N use for production, while minimizing environmental pollution will be adopted by the key stakeholders to improve food and nutrition security in sustainable way. Policy decisions to support the implementation of the good practices are also anticipated. The key stakeholders will therefore include farmer organizations, extension services, industry, suppliers of N inputs, agricultural NGOs, the Civil Society, regulatory bodies, policy makers, national and regional organizations inter-and national organizations, partner-state governments, etc.

While the proposed budget may be relatively small given the amount of work to be implemented due to the scarcity of relevant data, ongoing initiatives have provided a significant amount of co-financing. The additional budget from the project is considered as seed-money as additional investments to address the issue of N management may be made available when good results and the need of further investigation are clearly demonstrated. Currently, $270K is directly expected from the project, while the partners have been able to put together a co-financing of $ 1,661K as in cash and in-kind contribution.

Contents

Abbreviations

AGRA: Alliance for a Green Revolution in Africa

CBA: Cost-Benefit Analysis

CIFOR: Centre for International Forestry Research

CSO: Civil Society Organisation

DMG: Demonstration Management Group

EAC: East Africa Community

IITA: International Institute of Tropical Agriculture

ILRI: International Livestock Research Institute

LA-OMP: Laboratoire d'Aérologie – Observatoire Midi-Pyrénées

LVBC: Lake Victoria Basin Commission

INI: International Nitrogen Initiative

INMS: International Nitrogen Management System

INRA: '*Institut National de Recherche Agronomique'* [Note: French]

IPNI: International Plant Nutrition Institute

UGent: Gent University

MakU: Makerere University

NGO: Non-Government Organization(s)

N_r: Reactive nitrogen

N_rAE: Reactive nitrogen agronomic efficiency

N_rUE: Reactive nitrogen use efficiency

SAG: Stakeholder Advisory Group

1 Introduction to the EAST AFRICA Demonstration in 'Towards INMS'

1.1 Background and Context

1.1.1 The regional problem

The Lake Victoria nutrient concentration especially from nitrogen (N) and phosphorus (P) is a manifestation of atmospheric deposition, point sources through domestic and industrial effluent, and non point sources, e.g. river nutrient inputs originating from erosion, surface run off and leaching of applied fertilizer N. The relative contribution of each source still has to be well-understood. Nutrient loading is the key cause of the invasion of invasive weeds such as water lilies and hyacinth. Impacts of such water weeds include increased difficulty in collecting water, habitats for disease causing vectors, expansion of water body anaerobiosis with strong reductions in fish production, loss in fishing time and reduced functioning of urban water supply systems. Nutrient concentration determines the quality of water in a rivers system and is strongly linked to land use and land degradation. Important also, in terms of nutrient loading, is improper land use practices that lead to diffuse point pollution.

Nitrogen loading includes biological N fixation, atmospheric deposition, municipal and industrial waste. Excessive nutrient load into river systems has led to eutrophication at selected locations, causing massive growth in algae and other invasive aquatic weeds. This then disrupts the ecosystem equilibrium mainly due to oxygen depletion that affects fish breeding and conditions for other aquatic biota. Land use forms and events such as burning of biomass also contribute to nutrient loading and sedimentation of rivers in large water bodies. The situation is made worse by the population pressure of about 40 million people in Lake Victoria watershed and lack of alternative livelihoods sources. People often end up altering marginal lands and forest, and consequently exacerbating soil erosion and land degradation.

In East Africa, particularly the Lake Victoria Watershed there is too little nitrogen for crop, animal and human nutrition, while there is too much in selected water bodies (e.g. Lake Victoria) due to the enrichment effect. The too little is associated with minimum reactive nitrogen (N_r) application for crop production. The too much is related to N_r losses through excessive soil erosion, atmospheric deposition, poor management of crop-livestock systems, and municipal and industrial wastewater among others. As consequence the nitrate levels (NO_3-N) in selected sections of Lake Victoria could be as high as 16.2-87.9 µg L^{-1}. There is a need to accurately quantify the contribution of each main source of N_r loss to the Lake. The increase of Nitrogen has therefore caused a lot of problems in water quality and hence promotes algae and water hyacinth in the lake.

In particular, increased toxic growth of blue-green algae (cyanobacteria) cause the de-oxygenation of water, increased sickness for humans and animals drawing water from the lake, clogging of water intake filters, and increased chemical treatment costs for urban water supplies. Apart from the near-total loss of deepwater fish species, due to the expansion of the anaerobic zone in the last decades, there is a general trend in decreasing O_2 saturation even of the shallow water zone due to periodic upwelling of hypoxic water, which results in massive fish kills. In addition, increased algal and water weed growth affect fishing and transports of goods on the lake.

1.1.2 Overview of the intervention and rationale

The anthropogenic loads of nitrogen to Lake Victoria began to increase during the last century and by 1950 loading rates of these materials were well above natural baseline and continuing to increase. These increases in nutrient loading rates have led to the eutrophication of Lake Victoria at selected locations such as the Kisumu bay and further degradation of the Lake's water quality will occur unless the loading rate for N is reduced. This also includes the reduction of nutrient loads of P and organic carbon.

The East African Community (EAC) and partners have developed the Lake Victoria Basin Sustainable land management Strategy to address issues that negatively affect the quality of the Lake including N management. Initiatives aiming at addressing non-point pollution have been also developed, but some of them still have to be effectively implemented.

1.1.2.1 Atmospheric deposition

The lake Victoria Environmental Management Project Phase two (LVEMP II) funded by the World Bank is continuing monitoring atmospheric deposition; however no tangible activities are on the ground to address the sources for atmospheric N loading within Lake Victoria Basin. During LVEMP I air and rain samples were collected from stations at Bukasa and Lolui Islands and lakeshore stations at Entebbe, Jinja, Kadenge and Kisumu, representing the different rainfall zones of Lake Victoria to determine dry and wet atmospheric deposition in the Lake Victoria Basin. Also in Kenya, LVEMP II continues its deposition monitoring program. Results indicate that in general the northern coast and islands in the northern archipelago had the highest Total Nitrogen (TN) and Total Phosphorus (TP) as observed on Lake Victoria, suggesting that there may be a strong influence of air masses from the northwest affecting the TN and TP concentrations in rain over the Ugandan portion of Lake Victoria.

1.1.2.2 Industrial and municipal effluent discharge

The LVEMP II has designed waste water management initiatives including influent treatment facilities to reduce the amount of nutrients being loaded to the lake. This is done in Kenya (Bomet, Kisumu and Homa-bay); In Tanzania (Mwanza and Bukoba); and Uganda (Gaba, Kirinya and Jinja). Toilets are also built around beach management areas to limit direct nutrient flow into the lake and to protect shoreline fishery. The project is also implementing cleaner production initiatives in industries to reduce nutrient efflux.

1.1.2.3 Nature resources and agricultural sector

The LVEMP II has developed and is now implementing the Lake Victoria Sustainable land management Strategy. The strategy is aimed at reducing soil erosion while increasing land productivity. The initiative is implemented in all EAC Partner States within Lake Victoria Basin (e.g., Kenya, Uganda, Tanzania). However, the capacity of EAC Partner States to plan and have effective actions to address environmental issues related to nitrogen depends on reliable data, affordable technology and capacity building.

The agriculture sector is characterized by too little N_r due to insufficient N use for production. Various initiatives including efforts of the International Institute of Tropical Agriculture (IITA), the

Alliance for a Green Revolution in Africa (AGRA), International Plant Nutrition Institute (IPNI), the International Livestock Research Institute (ILRI), The International Fertilizer Development Center (IFDC), the Centre for International Forestry Research (CIFOR), and the International Centre for Research on Agroforestry (ICRAF) among others have shown interest in addressing the issue of too little N in the ecosystems. There is however a need to strengthen the interaction of the various initiatives for efficiency and consistence. Such initiatives aim at improving N_r use, and its agronomic efficiency (N_rAE), as well as use efficiency (N_rUE). Data generated will be modelled to assess the N_rAE and N_rUE improvement at scale as a result of the recommended interventions, which consist of participatory demonstration of profitable technologies and their scaling up.[1]

1.1.2.4 Stakeholder engagement

For significant adoption of the technologies intended to improve N_r management and reduce losses to the environment, stakeholder engagement is very critical. Innovation platforms including various stakeholders (e.g., policy makers, regulatory bodies, industry, local NGOs, scientists, extension agents, and local communities among others from all the partner states in East Africa) will be created to facilitate knowledge sharing and awareness creation. To ensure scalability of the knowledge and the know-how, representatives of other Africa regions will be invited to the main workshops. The Demo management team will also collaborate with the teams managing other demo sites to share experience.

1.1.2.5 Monitoring and evaluation

The ultimate goal of the intervention is to reduce the N losses to the environment, while improve N use for production. Mechanisms to verify the changes using N partial budgets will be applied taking into consideration the various sources and related management. Lessons learned will be applied to improve the project targets.

1.1.3 Result of the interventions at both national and regional levels

The interventions will determine the relative contribution of each N source such as e.g. soil erosion and the measures to improve the N use of a particular source, while minimizing losses to the environment from such a source. As a result, the cumulative effort should result in improved N_rAE and N_rUE, and reduction of losses to the environment.

It is expected that the innovation platforms will create enabling environment for development of good practices to improve N management for each source and result in implementation of effective policy decisions to increase N_r use for production, and reduce losses to the environment.

Specifically,

1) N flows by source sector and loss pathway will be determined and data access improved by proper definition of the critical data

[1] Note that there are currently differences of view across the INMS community on the definitions and most appropriate form of nitrogen indicators for different purposes. The community includes inputs from IITA, GPNM, INI, TFRN, EU-NEP, OECD and many others. The topic of harmonization and relationships between the different indicator forms is addressed in Activity 1.1 and Activity 3.3.

2) Uncertainties for partial N budgets for East Africa will be reduced as a result of the improved access to data
3) Innovation platforms will be created to discuss the benefits and threats of N_r in East Africa to inform policy decisions and good practices for N management across source sectors
4) The Innovation platforms will agree on the N_r performance indicators to monitor the effectiveness of the various interventions
5) Available options for better N management, , including increased use of synthetic fertilizer to boost crop and feed production, will be reviewed and evaluated for their applicability in the context of East Africa
6) Participatory demonstration and scale up of the options retained by the innovation platform will be conducted to determine the potential barriers for adoption, and the success stories as well
7) Best practices and policy decisions from the other demonstration sites worldwide will be considered for evaluation 'as is' or after modification in East Africa to minimize duplication of efforts
8) Best practices and policy decisions developed in East Africa will be communicated to the other demonstration sites worldwide for consideration.
9) The capacity of the local partners will be built to ensure effective implementation of the best practices and policy decisions to increase N_r use for production, while reducing environmental pollution.

1.1.4 Contributions to the INMS understanding/process

The East Africa Demonstration of 'Towards INMS' will cooperate in close engagement with the other demonstrations of Component 3 in order to facilitate the development and implementation of a common approach, while allowing for priority issues according to regional needs to be incorporated. This process has already been ongoing during the INMS PPG phase, with contributions from the Director of the INI African Regional Centre, IITA, ILRI and LVBC in attending both the Demonstrations Preparatory Meeting (March 2015, Germany) and the INMS Plenary Meeting (April, 2015, Lisbon). The background for this contribution has also been supported by earlier strategic development through INI and with UNEP, including at the First United Nations Environment Assembly (INI, IITA, ILRI, NERC).

1.1.5 Relevance to national and regional policies

The knowledge generated by the interventions will be very crucial for development of agricultural, water, land management, and environmental policies, since it will show pathways for how an integrated N management might on the one hand lead to increased food and feed production while on the other hand the environmental impact of N_r can be reduced. The active participation of the Lake Victoria Basin Commission (LVBC), local institutions relevant for such policies, is a great asset for the success of the policy recommendations. Interactions with the other demonstration sites at the global level as well as the innovation platforms will ensure the development of science-based policy decisions.

1.1.6 Relevance to global / regional agreements and conventions

Lake Victoria is bordered by several countries and is thus an international lake feeding into the Nile. It thus not only benefits East African Community people, but also the Nile basin countries. The reduction of nitrogen in the Lake Victoria will benefit all Nile partner States; hence contribute to better water quality; and reduction of health problems. This will reduce conflicts among countries; and hence address regional agreements and conventions related to transboundary water resources management. Equally important, the intervention area matches the goal of the global agreements such as Global Partnership for Nutrient Management (GPNM), Global Programme of Action to protect the marine environment from land based activities (GPA), INI, and the Convention on Biological Diversity (CBD) among others.

1.2 Environmental threats, root causes and barrier analysis

1.2.1 Description of the sources, pathways and impact of N (or issues associated with too little – food security etc.)

The main N_r sources include biological nitrogen fixation, N fertilizers, animal manure, fuel, mineralization or burning of various agricultural and forest residues, etc. The main pathways of N losses to the environment include atmospheric deposition, runoff together with soil erosion from the agricultural areas and natural systems, discharge of insufficiently treated wastewater into water bodies from the industry and municipal areas among others. With respect to too much N in water bodies, the actual contribution of each source still has to be adequately evaluated. Too much N caused eutrophication of selected water bodies such as sections of Lake Victoria, loss of water quality for recreation and drinking, reduction of fish population. Poor N management also contributes to greenhouse gases and leaching. The too little is associated with insufficient N use for crop and feed production, which has resulted in mining of soil N stocks and obvious signs of N deficiencies such as low crop yields and low nutritional value of the yields, all resulting in food and nutrition insecurity.

1.2.2 What has prevented N management being addressed in the region before

There have been some initiatives in the region to improve N management and to increase the use of synthetic and organic fertilizers for crop and feed production. However, they have been some challenges in adoption of selected technologies such as fertilizers mainly because of cost, accessibility issues and – due to the depletion of many soils in nutrients and carbon stocks - the need to apply fertilizers across several seasons to see significant increases in yields. Insufficient research has also not been conducive for science-based policy decisions. Inadequate investment in infrastructure such as effective wastewater treatment facilities, erosion control structure, and distribution network of technologies intended to improve soil and N management have also contributed to the lack of sustainability or scalability of proven technologies. This initiative should review those barriers and recommend practical solutions. The innovation platforms including a high diversity of stakeholders will probably enable to generate innovative solutions to the current barriers.

1.3 Institutional, sectoral and policy context

1.3.1 The main organisations (government and others) involved in N related issues

Majority of the international research organizations such as IITA, AGRA, IPNI, and IFDC among others, as well as the national ministries of agriculture, environment, and health are trying to address the N_r issues. LVBC also is actively involved in the development of policies intended to improve N management at national and regional levels. Teaching institutions in the East Africa are also building the capacity of the current and future generations to address the challenges related to N with respect to food security & quality, as well as environmental issues.

1.3.2 Main private sector organisations (industry, farmers, etc) and where N used/produced etc

While the industry is somehow involved in the agricultural sector, its voluntary contribution to solve the environmental issues remains a challenge. Also except for biological inoculants, there is currently no N fertilizers industry in East Africa, though there are ongoing efforts to get N fertilizer plants operational in countries such as Ethiopia. A few companies in the region are mainly involved in blending fertilizers. It is worth mentioning that selected industries have adopted clean production technologies in collaboration with LVBC commission to recover most of the nutrients from wastewater before discharge to the water bodies. The next steps should be the use of the bio-fertilizers in agricultural production.

Farmers tend to rely on local available inputs, such as animal manure, which do not require additional investment. However, manure management strategies are poorly developed and current practices are often associated with major nutrient losses to the environment in form of nitrate leaching, NH_3 volatilization, and denitrification N gas losses. ILRI has currently developed manure management guidelines for smallholders which might help to increase adoption rate of innovative technologies for manure management. Barriers for adoption are often costs, lack of awareness, poor accessibility of the inputs in remote areas, insufficient crop responses due to poor crop management and environmental factors such as rainfall among others. The innovation platforms should address the challenges faced by farmers to improve the adoption of profitable and clean technologies to improve the use of N for production, while reducing environmental pollution. In fact, farmers need to improve the management of animal manure to minimize N losses during storage.

The contribution of the private sector in monitoring the N management and evaluate areas of improvement is lacking in East Africa. Very few laboratories are involved in assessment of the environmental impacts of N_r and majority of them are not well-equipped to do the work. It is not uncommon to see samples shipped outside East Africa and even out of Africa for analysis due to lack of local capacity. The costs implication makes it difficult to have regular monitoring and evaluation of the changes over time.

1.3.3 What national policies are in-place / planned

One of the policy related to too little N use for production is the Abuja Declaration during the African Fertilizer Summit in 2006 to increase fertilizers use at least to 50 kg nutrients ha^{-1}, the current average is less than 10 kg nutrients ha^{-1}. Policies for wastewater management, reduction of residue burning, protection of forest reserves and marginal lands, have been developed, but require adequate implementation and enforcement. Some of the policies are applicable at the national levels, while others are applied at the regional level. LVBC facilitates the formulation of regional policies and the improvement of national ones.

1.3.4 NGO and CSO activities

Most of the international research organizations mentioned above, which are based in East Africa fall in the category of NGO and contribute to improvement of N management. Other NGO present in East Africa in the area of agriculture include for instance Farm Inputs Promotion – Africa (FIPs), Once Acre Fund, and African Fertilizer Agribusiness partnership among others. Various local NGO in the area of environment also exist, and advocate for better environmental policies. The capacity of selected local NGOs remain relatively weak; however, the main ones will be considered in the innovation platforms.

2 Baseline for the EAST AFRICA Demonstration in 'Towards INMS'

2.1 Baseline analysis

2.1.1 Previous work that is relevant to the work of this project

LVBC has been working with the partner states to develop a sustainable land use strategy including protecting the ecosystems against inadequate management of nutrients (e.g. N_r). Two IITA projects (COMPRO-II and N2Africa) are promoting various technologies to improve nitrogen use efficiency as well as agronomic efficiency. Enough data will be generated to facilitate the estimation of N use efficiency and agronomic efficiency at scale. A preliminary N budget has been conducted for the Lake Victoria Catchment and areas of uncertainties identified (ILRI and CIFOR). This project will build on this expertise. Similarly, Lake Victoria Basin Commission has tried to quantify the contribution of each source though the results have to be cross-validated before publication. The Ghent University is also trying to assess the various sources in selected locations of Kenya (within the Lake Catchment) to determine the various sources and estimated contribution using advanced techniques (e.g. isotopic method). Preliminary data on N deposition in Africa, greenhouse emission, and N losses through leaching and erosion exist and needs to be updated and cross-validated. Hence the project will not start from scratch though data management, cleaning, and analysis may require improvement. The majority of the project team consists of experts who were involved in the previous studies, either in East Africa or in similar conditions in Africa.

2.1.2 Relevant activities undertaken to 'manage' N

- Assessment of the partial N budget in the Lake Victoria Catchment (published in 2014): International Livestock Research Organization & Center for International Forestry Research
- Identification of the uncertainties affecting the accuracy of the N partial budget (published in 2014 by Zhou et al.): International Livestock Research Organization
- Isotopic assessment of the contribution of the N sources to N loading in water bodies (ongoing): Ghent University and University of Nairobi
- Awareness creation of technologies intended to improve N agronomic efficiency and use efficiency through participatory demonstration and communication (ongoing) International Institute of Tropical Agriculture: COMPRO-II & N2Africa projects

- Wastewater treatment to minimize nutrients (e.g. Nr) loading into the lake (ongoing): Lake Victoria Basin Commission
- Workshop to promote the adoption of technologies intended to improve N use for production, particularly biological nitrogen fixation (ongoing) International Institute of Tropical Agriculture: COMPRO-II project
- Development of manure management and training guidelines (ongoing): FAO initiative in which the International Livestock Research Organization is involved in.
- Policy development to improve N management to increase crop productivity, while reducing it is negative impact on ecosystems (ongoing): International Institute of Tropical Agriculture: COMPRO-II project

2.1.3 GEF actions

This project will represent the first nitrogen management demonstration site of its kind in East Africa. However, various initiatives supported by UNEP have been implemented (or are under implementation) in the region (see Table A17d1) which connect to the nitrogen issue. The recent publication of the partial N budget for the Lake Victoria Catchment was also facilitated by GEF actions.

Table A17d1: *List of relevant GEF projects linked to the East Africa Demonstration region.*

GEF ID	Project Name	Region	Completion Date	Linkage with this project
5272	Scaling up Sustainable Land Management and Agrobiodiversity Conservation to Reduce Environmental Degradation in Small Scale Agriculture in Western Kenya	Kenya	Council Approved	Provides information on land management practice in Western Kenya
9070	Food-IAP: Fostering Sustainability and Resilience for Food Security in Sub-Saharan Africa - An Integrated Approach (IAP-PROGRAM)	Regional	Council Approved	Provides information of food security in the region and stakeholders involved in food production
4940	Implementation of the Strategic Action Programme for the protection of the Western Indian Ocean from land-based sources and activities (WIO-SAP)	Regional (inc Kenya)	Council Approved	Provided information on the assessment of the impacts of land based activities to the Western Indian Ocean
5674	Lakes Edward and Albert Integrated Fisheries and Water Resources Management Project	Regional (inc. Uganda)	Council Approved	Provides information on the status and scales of fisheries and freshwater ecosystem health in the region
5691	Sustainable Land Management of Lake Nyasa Catchment in Tanzania	Tanzania	PIF Approved	Provides information on land management practices within the region
5718	Integrated Landscape Management for Improved Livelihoods and Ecosystem Resilience in Mount Elgon	Uganda	CEO Approved	Provides information on landscape management in the region and network of stakeholders
4533	Development of Tools to Incorporate Impacts of Climatic Variability and Change in Particular Floods and Droughts into Basin Planning Processes	Global (Lake Victoria Basin – Pilot).	CEO Endorsed	Provides information on how to incorporate climate change impacts in basin planning processes

2.1.4 Other donors

The demonstration of the technologies intended to improve N use in production on profitable and sustainable way is mainly supported by the Bill and Melinda Gates Foundation. The wastewater treatment facilities are supported partially by the World Bank and partner states in the Lake Victoria Catchment.

2.1.5 Nationally funded

For the project mandate area majority of the environmental initiatives are funded in the context of LVBC, in addition to environmental related efforts at specific-country level. In the agricultural sector, the main contribution at the country level is the subsidies on agricultural inputs mainly fertilizers including nitrogen. Selected countries have tried to comply with the recommendation by the New Partnership for Africa's Development (NEPAD) through the Comprehensive Africa Agriculture Development Programme (CAADP) to invest 10% in the agricultural sector particularly the improvement of application of innovative technologies in the production system for sustainable intensification.

2.1.6 Planned work that will contribute to the baseline/CF

Refer to Section 2.1.2

2.2 Gaps

2.2.1 What are main gaps in the region with respect to:

2.2.1.1 N policies

Most of the available policy documents are not specific to nitrogen. They are related to nutrients in general. As a consequence, there is a need of specific N policies, which will take into consideration the comprehensive N cycle, as well as the full N chain for adequate assessment of the NUE. Such policies would have clear agronomic and environmental targets.

2.2.1.2 N practices

The N performance indicators developed elsewhere such as NUE may not be suitable to the East Africa, a region where too little N is used for agricultural production. Agronomic use efficiency has been considered as an outstanding indicator in East Africa; however, it has not been evaluated at scale. Management of the N inputs including recommendations for use or storage and handling conditions are not well understood. This normally results in poor agronomic efficiency and significant losses to the environment.

2.2.1.3 Scientific understanding

There is sufficient understanding of the challenges related to too little and too much N in East Africa. However, the main issues are the understanding of the magnitude and quantification of the problem, as well as implementation of relevant solutions. Insufficient funding of research on the full

N chain exacerbates the issue. Capacity building is also required to improve the local scientific skills and competence to address the N management challenges in the region.

2.2.1.4 Funding for these

Most of the funded projects in East Africa are donor-based with little contribution from the national systems. The focus is mainly on food security, with little or no emphasis on environmental issues. To address the above issues adequate funding is required. A key contribution of Towards INMS could be seen as seed money to develop other proposals once a research strategy to effectively address the key issues related to N management in East Africa is developed in the early stage of the demonstration site.

2.3 Stakeholder analysis

2.3.1 Who are the main producers/users of N

In East Africa, there are no producers of N inputs, but suppliers and retailers. The main users are farmers. If one considers the full N chain, then the producers could be mainly the feed and food industry as well as farmers for food crops, whereas the users would include animals and human beings.

2.3.2 Who are the main stakeholders

The main stakeholders include farmers, extension agents, N retailers and suppliers as well as blenders (industry), scientific community (plant, animal, and human nutrition; environmental scientist), regulatory bodies, policy makers, national governments, regional and international organizations including NGOs, as well as the Civil Society.

2.3.3 Role of the government in N management

The governments in the region are involved in N management mainly in the context of the sustainable land management strategy of the LVBC. They also develop policies intended to facilitate farmers' access to N inputs such as subsidy programs. Investments in wastewater treatment facilities also represent a contribution of governments to N management. Government measures/decisions related to agro-environment promote better N management. The measures are generally phrased as nutrient management, which by default includes N. Additional efforts may be required to single out specific N issues.

2.3.4 Role of the private sector (including farmers)

As mentioned above the private sector facilitates access to N inputs. However, in the rural areas of East Africa additional efforts are required to improve the distribution network. Public private partnership seems to be required to control the prices of the N inputs to ensure adoption by farmers. Farmers are generally the end users of N inputs and their practices determine the agronomic efficiency and environmental threats of N in the farming areas.

2.3.5 Role of the NGOs/Civil Society Organisations (CSO)

The NGOs generally facilitate farmer access to N inputs through various initiatives. Their contribution is highly depended on availability of funds from donor; hence, the actions are not sustainable in most of time. Once they terminate their initiatives farmers tend to go back to the traditional practices. There is a need to ensure sustainability of the good practices promoted by NGOs. Civil Society normally brings to the attention of governments and inter- national organizations benefits and threats associate with nutrient use in production. The contribution of Civil Society is also affected by availability of donor funding.

3 Project Description for the EAST AFRICA Demonstration in INMS

3.1 Strategy

3.1.1 General information

The work plan described in this Appendix forms part of the overall execution of INMS Component 3 on the Regional Demonstration of the Full Nitrogen Approach. The rationale for this broader approach is described in Appendix 17. The development of a common strategy to all the Regional Demonstrations in INMS is an iterative process and has already benefited from three workshops connected with the PPG Phase. This strategy aims to a) provide sufficient common approach to allow comparability between the different regional demonstrations, especially when synthesizing and applying the results (Activities 3.2-3.4; Activities 2.2-2.4); b) provide sufficient scope to allow regional priorities to be addressed according to the different regional needs.

3.1.2 Consistency and relevance to national and regional policies/priorities

Improving food and nutrition security, while minimising environmental pollution, is one of the key priorities for East Africa. Policies intended to improve N agronomic efficiency and use efficiency are crucial to meet the goal. Understanding the N cycle and budget in East Africa will significantly contribute to the LVBC sustainable land use strategy.

3.1.3 Partners

Participation in the project is on voluntary basis. However, the initiators have tried to reach out to key stakeholders with relevant expertise in N management and experience in the region. The partners who voluntarily showed interest in the project will identify local stakeholders to include in the project implementation for high impact. Table A17d2 shows the current partners. As stakeholders show interest, they will be considered based on the expertise and experience in the region.

Table A17d2: *List of partners and key contributions.*

Key partner organizations	Representative (contact information)	Key Contribution	Role in the project team
International Institute of Tropical Agriculture	Cargele Masso (INI Regional Centre Director for Africa) (C.Masso@cgiar.org); Peter Ebanyat (P.Ebanyat@cgiar.org); Frederick Baijukya (F.Baijukya@cgiar.org)	Secondary data, data collection, technology demonstration.	Coordination (main coordinator: Cargele Masso)
Lake Victoria Basin Commission	Frederick Mhina Mngube (mngube@lvbcom.org)	Policy, secondary data, data collection, sentinel sites, technology demonstration.	Coordination (associate coordinator)
International Livestock Research Institute	Klaus Butterbach-Bahl/ David Pelster (k.butterbach-bahl@cgiar.org/ d.pelsterQcgiar.org)	Secondary data, data collection	Member (leading the N budget development)
Ghent University	Pascal Boeckx (pascal.boeckx@ugent.be)	Secondary data, data collection	Member (leading the quantification of N source contribution)
Laboratoire d'Aérologie Observatoire Midi-Pyrénées	Corinne Galy-Lacaux (Corinne.Galy-Lacaux@aero.obs-mip.fr)	Secondary data, data collection	Member (leading the atmospheric deposition and emission components)

3.1.4 Outputs and activities

Project Objective: To improve the understanding of the East Africa N cycle and investigate practices and management policies at the regional, national and local levels with a view to reduce negative impacts of reactive nitrogen on the ecosystems

Outcome 3.1: GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised

Output 3.1: A demonstration activity which delivers conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing: Case 2 (Challenges and opportunities for developing areas with insufficient reactive nitrogen).

Note that although Towards INMS characterizes the East Africa Demonstration primarily under Case 2 (Challenges and opportunities for developing areas with insufficient reactive nitrogen), the region is complex and also includes elements of N pollution problems according to Case 1 (Challenges and opportunities for developing areas with excess reactive nitrogen). In regard to the former, challenges include improving N agronomic efficiency and use efficiency at landscape scale within the Lake Victoria catchment, while for the latter they include the challenge to reduce eutrophication of water bodies in East Africa i.e. Lake Victoria. This juxtaposition shows how low nutrient use efficiency can contribute to environmental pollution losses even in areas with modest or low N inputs. It means that there is an even larger challenge to show how N pollution could be reduced simultaneously with a future scenario of increasing N use in East Africa.

The demonstration area sits under the following Activity:

Activity 3.1: Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.

This Activity contains the following Tasks (see also Figure A17d1):

1) **Task 3.1.1 & 3.1.2:** Examination of N flows by source sector & loss pathway; and improving access to data
2) **Task 3.1.3:** Identifying & quantifying major uncertainties and means to improve
3) **Task 3.1.4 & 3.1.5:** Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA
4) **Task 3.1.6:** Description in relation to N performance indicators, in co-operation with global analysis
5) **Task 3.1.7:** Review of available options for mitigation/better N management, co-benefits/trade-offs
6) **Task 3.1.8:** Profiling success stories, barriers to change, and demonstration of N joined up approach

Further details of these tasks are outlined in Figures A17d2 to A17d4 and described in Appendix 17.

3.1.5 Linkages with GEF and non-GEF interventions

This initiative will link with the IITA project on legume technologies to improve soil and crop productivity through enhanced access to N. It will also link with the sustainable land use strategy of LVBC. It will also build on the knowledge generated by ILRI for partial N budget assessment, UGent for source sector quantification using isotopic methods, and Laboratoire d'Aérologie Observatoire Midi-Pyrénées for atmospheric N deposition and emission quantification.

3.2 Project Sub-components and activities

The project partners have been selected based on their expertise. Task 3.1.1 and 3.1.2 will be mainly addressed by UGent, ILRI and laboratoire d'Aérologie as mentioned in Table A17d2. The focus will be on addressing the issue of too much N in water bodies, which has contributed to eutrophication. The issue of uncertainty will be addressed by ILRI in collaboration with CIFOR when conducting a partial N budget (Task 3.1.3) . LVBC will engage policy makers using their existing network with partner states and scientists (Tasks 3.1.4 and 3.1.5). Innovative platforms will be created to discuss relevant performance indicators (Task 3.1.6 and 3.1.7). IITA and LVBC will implement the sentinel sites for demonstration of good practices for N management to improve its use for production, while minimizing environmental pollution (Task 3.1.8). The project partners above will interact with other demonstration sites to share experience, tools, and lessons learned (3.1.9). For other details, the global framework below will be adopted. The outcomes will also feed in to inform developments in Component 2 in, A2.2 – global consolidated assessment & A2.3 - methods for better N management.

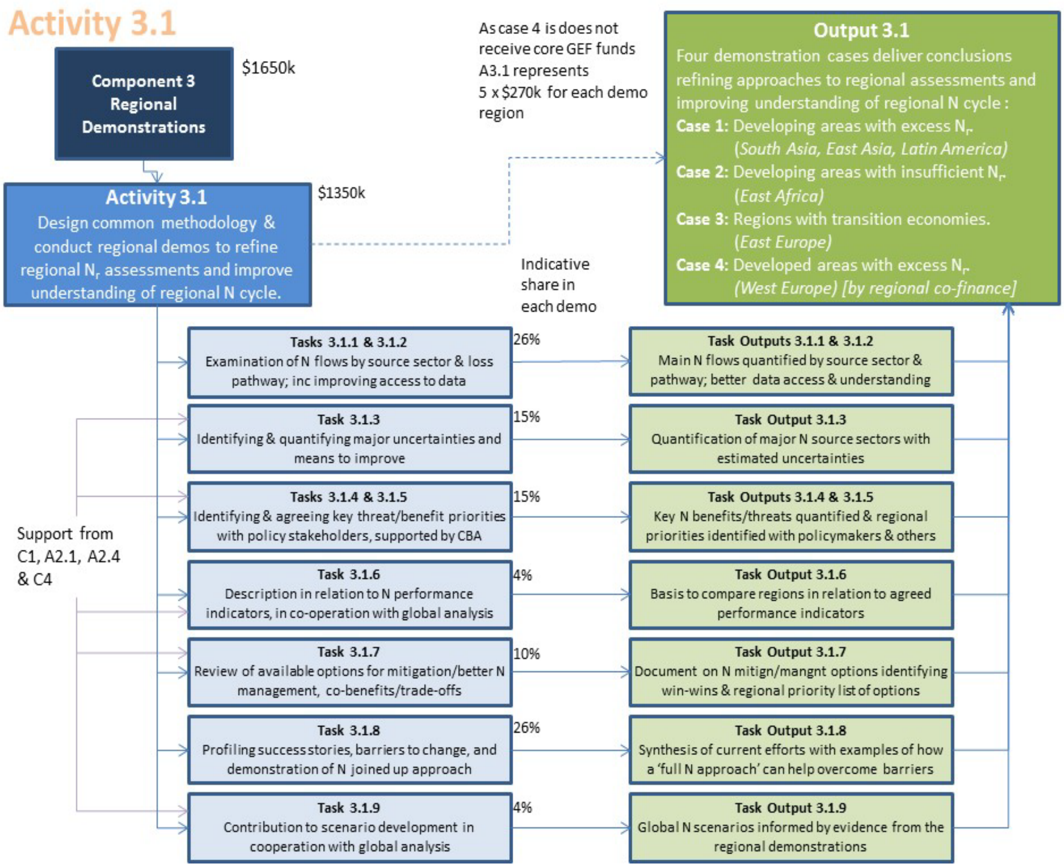


Figure A17d1: *Structure of Activity 3.1, at Task and Task Output level.*

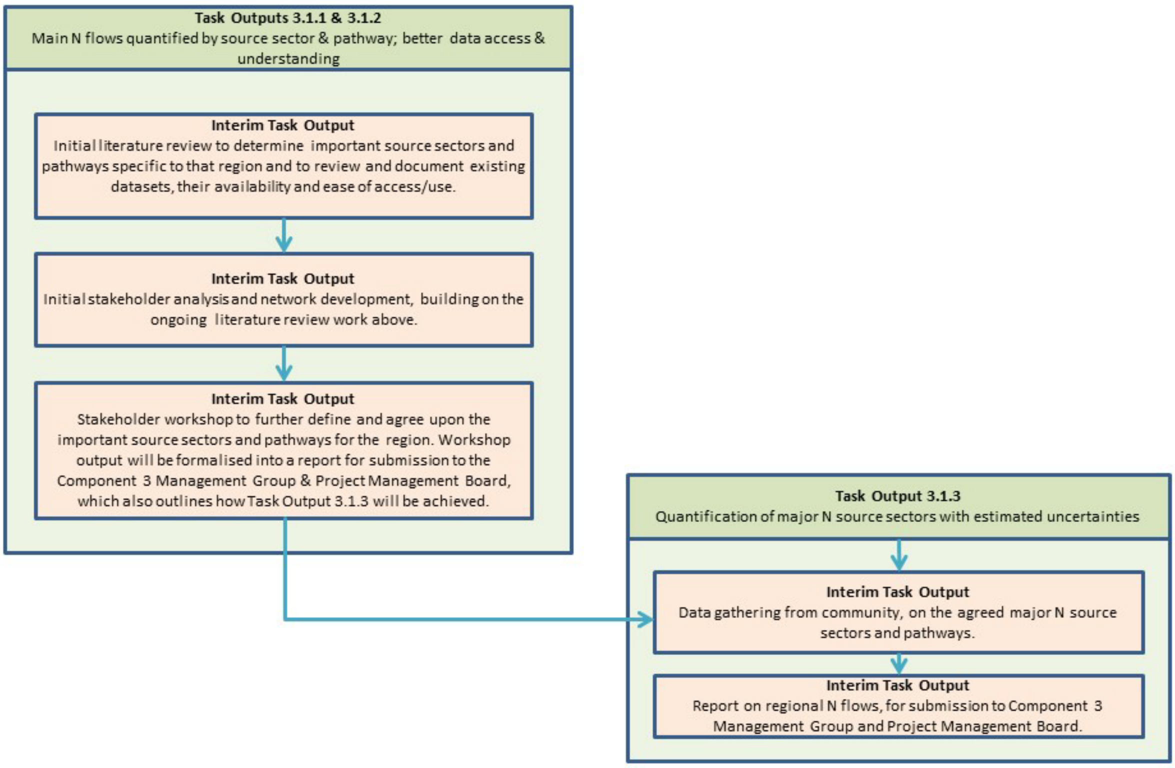


Figure A17d2: *Interim Task Outputs for Task Outputs 3.1.1, 3.1.2 & 3.13 and how they are linked.*

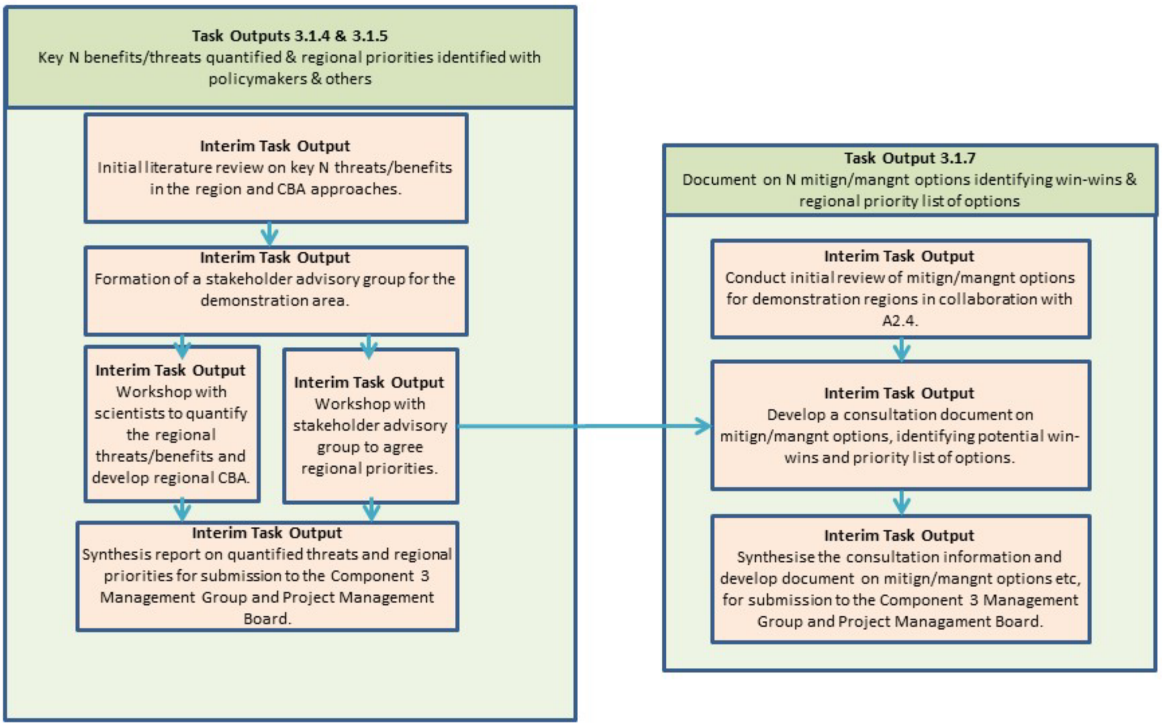


Figure A17d3: *Interim Task Outputs for Task Outputs 3.1.4, 3.1.5 & 3.1.7 and how they are linked.*

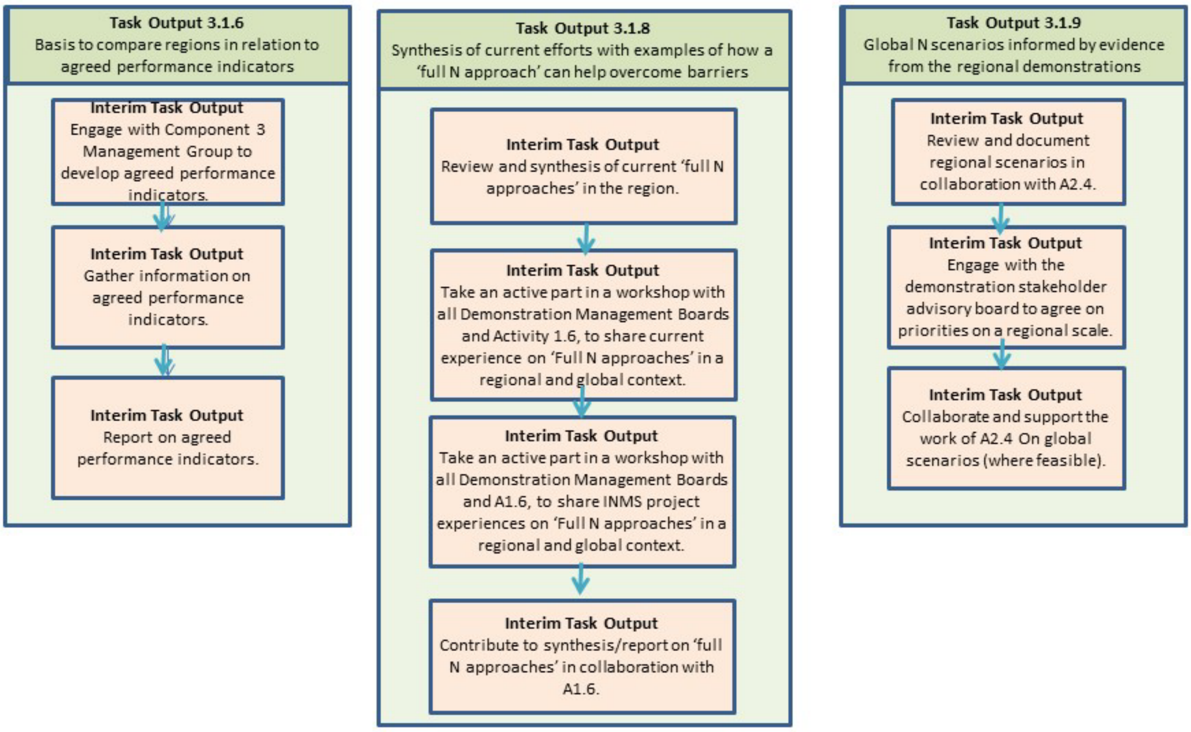


Figure A17d4: *Interim Task Outputs for Task Outputs 3.1.6, 3.18 & 3.1.9 and how they are linked.*

3.3 Budget and co-financing

3.3.1 Budget

Table A17d3: *Budget breakdown by cost type*

Cost Type	Cost per year (USD)	Cost for project [4 years] (USD)	Notes
Establishing and supporting a regional team			
Regional Co-ordinator	N/A	N/A	In-kind contribution
Project Officer 1 (MSc level) for data collection	15,000	60,000	Full time
Consultant (for data collection planning and analysis)	10,000	40,000	One month straight time
Office and admin costs (including printing budget for dissemination materials)	3,000	12,000	Communication tools
Total	***28,000***	***112,000***	
Support for meetings (including travel and venue budgets, preparing communications, reports and experiences)			
Travel & Subsistence Costs	10,000	40,000	Local travel
Venue and Catering Costs	7,500	30,000	Location with the Lake catchment
Preparing reports etc.	5,000	20,000	Facilitator
Total	***22,500***	***90,000***	
Additional bought in Services (e.g. to supplement key datasets, additional necessary information etc)			
Total	***17,000***	***68,000***	*Participatory demos*
Total for Demonstration	**67,500**	**270,000**	

Table A17d4: *Budget breakdown by Task*

Task	Cost (USD)	Notes
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; and improving access to data	60,000	**Literature and data review, Sample analysis**
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	40,000	**Modelling**
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	30,000	**Workshop**
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	5,000	**Workshop**
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	25,000	**Workshop**
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	100,000	**Participatory demonstration of good practices**
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	10,000	**Workshop**
Total	**270,000**	

3.3.3 Co-financing

Table A17d5: *Co-financing budget listed by Task and Partner*

Task	Co-financing (USD)	Partner	Notes (including information on the project, links to the tasks, project duration etc.)
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	**685,000**	**ILRI; LA-UMR; LVBC; UGent**	**Nitrate monitoring in water bodies, atmospheric deposition**
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	**96,000**	**ILRI, LA-UMR**	
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	**60,000**	**IITA**	**COMPRO-II (2017)and N2Africa (2018)**
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	**440,000**	**IITA**	**COMPRO-II (2017)and N2Africa (2018)**
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	**200,000**	**IITA**	**COMPRO-II (2017)and N2Africa (2018)**
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	**100,000**	**IITA**	**COMPRO-II (2017)and N2Africa (2018)**
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	**-**	**-**	**-**
TOTAL co-financing	**1,581,000**		

3.4 Work Plan

Activity 3.1: East Africa Demonstration Site	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 3.1.1 & 3.1.2 Examination of N flows by source sector & loss pathway; inc improving access to data						W	R									
Task 3.1.3 Identifying & quantifying major uncertainties and means to improve													R			
Task 3.1.4 & 3.1.5 Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA (*science workshop, **stakeholder workshop)				W*			W**				R					
Task 3.1.6 Description in relation to N performance indicators, in co-operation with global analysis													R			
Task 3.1.7 Review of available options for mitigation/better N management, co-benefits/trade-offs										R			R			
Task 3.1.8 Profiling success stories, barriers to change, and demonstration of N joined up approach					W							W		R		
Task 3.1.9 Contribution to scenario development in cooperation with global analysis																
Monitoring and Evaluation									MR							TR

__M__ = Meeting, __R__= Report (includes other publications), __W__ = Workshop, __S__ = Communication Strategy, __MR__ = Mid-term Report, __TR__ = Terminal Report, __I__ = Project website

NOTE: the timing of the outputs are indicative; these will be finalized on project inception and subject to review during project implementation

3.5 Sustainability

The innovation platforms including various stakeholders, mainly member states, are intended to ensure the sustainability of the project as result of policy recommendations and decisions, as well as awareness creation about the best practices to improve N use for production, while minimizing environmental pollution.

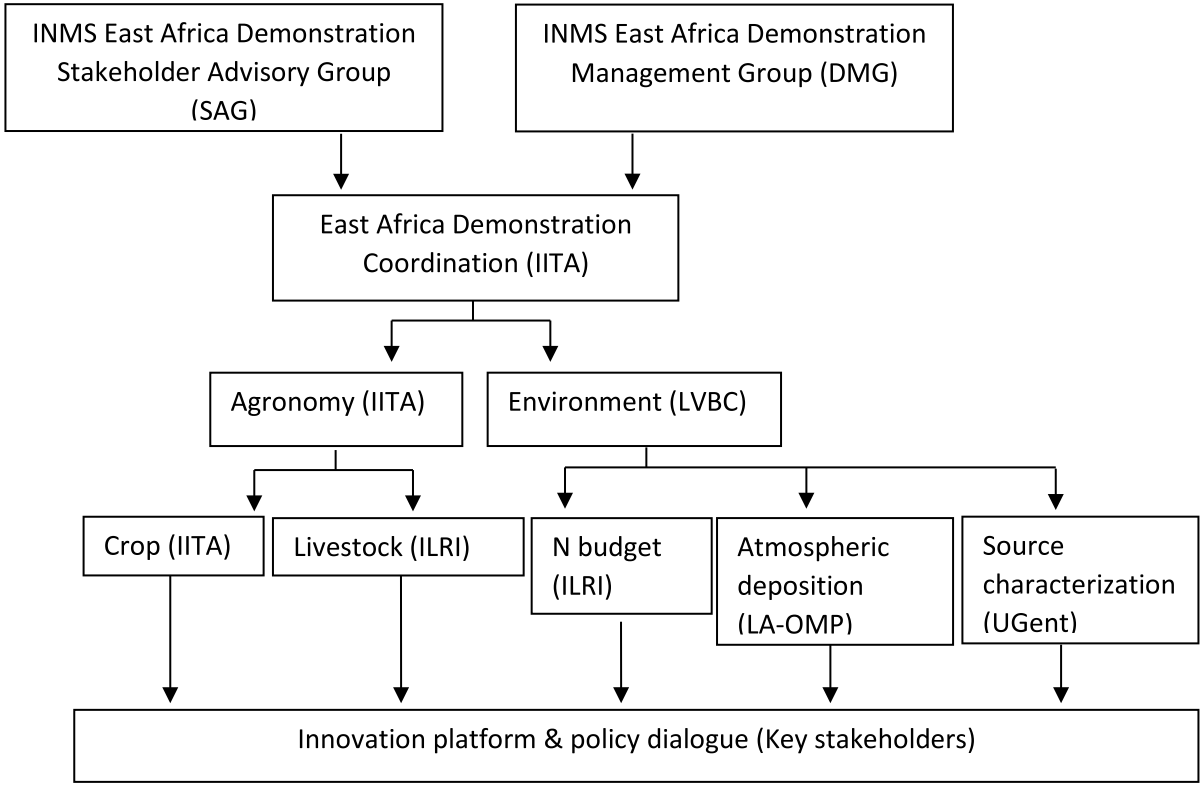
3.6 Replication

The scientific advisory committee (SAC) for the East African Demonstration will include representatives of various regions of Africa for awareness creation and training. The knowledge created in East Africa will be used on Central, Southern, West, and North Africa to address challenges related to N_r. Synergies with the wider INI network in Africa and other networks will be fully exploited. Similarly some components developed in East Africa will be communicated to the other demonstration regions across Towards INMS Component 3 for consideration in the context of the project. Also, the East Africa demonstration site will learn from the other demonstration sites and adopt selected practices intended to improve efficiency and effectiveness. This will especially benefit from the common annual plenary meetings of the Towards INMS project.

3.7 Awareness raising, communications and dissemination

The project team will identify the key stakeholders (audience analysis) and develop communication tools and messages accordingly. The innovation platforms will be used to fine-tune messages. Adequate communication channels will also be identified to ensure effectiveness and high outreach. The messages will be mainly based on the key recommendations of the project and the innovation platforms. The type of stakeholders mentioned above will be involved. The main goal will be to ensure that communities adopt the best practices for N management, policy makers use scientific evidence to develop relevant policies. The communication strategy will also take into consideration the need for sustainability and scalability (replication).

3.8 Execution arrangements



Notes

The SAG of the Demonstration Region includes the 7 members of the executive committee of the Africa Regional Centre of the International Nitrogen Initiative (Rebbie Harawa of the AGRA (Southern Africa), Mateete Bekunda of IITA (East Africa), Shamie Zingore of IPNI, Mariana Rufino of CIFOR (Central Africa), Bussie Maziya-Dixon of IITA (West Africa), SIFI Bouaziz of INRA-Tunis (North Africa), Cargele Masso of IITA (INI Regional Director), and Frederick Mhina Mngube of LVBC)

The Demonstration Management Group consists of Cargele Masso, Peter Ebanyat, and Frederick Baijukya (IITA), Fredrick Mhina Mngube (LVBC), Klaus Butterbach-Bahl & David Pelster (ILRI), Corinne Galy-Lacaux (LA-OMP), and Pascal Boeckx (UGent).

4 Monitoring and Evaluation

4.1 Demonstration Project Results Framework

The present detailed log-frame (project results framework) covers aspects that are specific to the East African Regional Demonstration. It should be read in conjunction with the project results framework for Component 3 as a whole (see Appendix 17), which emphasizes common aspects between the different INMS demonstration regions.

	Objectively Verifiable Indicators			Sources of Verification	Assumptions
Outcomes, Outputs and Activities	Indicator	Baseline	Target		
Outcome 4: GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised	Project-level demonstration methodology guidelines adopted and published Requests for and application of demonstration area methodologies, tools and practice by external parties	Limited information from previous GEF interventions and partial N budget recently developed.	Project level methodology developed and agreed. Uptake of demonstration area methodology in other areas.	Workshop reports Contribution to synthesis documents	Active participation of the populations and policy makers in East Africa Availability of diversified expertise and technologies in East Africa

Output 3.1: A demonstration activity which delivers conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing:	Report on N sources and N flows for East Africa.	Lack of joined up data on N sources and flows regionally.	Quantified N flows, with uncertainty indication by end Year 3.	Reports, contrib'n to global synthesis (A2.2).	
Case 2: Challenges and opportunities for developing areas with insufficient reactive nitrogen.	Report on consensus on N priority sources, forms and impacts for East Africa.	Lack of knowledge on how N sources and impacts fit together.	Clearly identified priorities for N sources, forms and impacts by end Year 3	Reports of science-stakeholder workshops.	
(Note that some aspects are also relevant to Case 1: Challenges and opportunities for developing areas with excess reactive nitrogen)	Regional condition according to agreed N performance indicators.	Lack of knowledge on how different N indicators relate, especially at regional level.	Statement of East Africa performance in using agreed N indicators by end Year 3.	Report and contribution to INMS publications.	
	Information on priority N management and mitigation options.	Diversity of views and lack of consensus on the best methods to obtain N co-benefits.	Draft 'Top 10' priority measures for improved N management for East Africa (end Year 2).	Report provided to A2.3 for incorporation in global comparison.	
	Information on successes and opportunities.	Variable progress, with limited attention to linking N co-benefits	Document for East Africa, showing how N approach can address barriers and share success stories (Year 4).	Documents for East African demonstration.	
	Information on regional specificities for global scenarios	Existing global scenarios paying insufficient attention to regional conditions.	Global scenarios informed by evidence from East Africa Demonstration (Year 3).	Report from A2.4 workshop.	

The following topics are also included: • Regional demonstration to increase Nr agronomic efficiency in East Africa • Regional demonstration to increase Nr recovery from wastewater in East Africa	Field trials in regional demonstration activities show an improvement of 20% in Nitrogen Agronomic Use Efficiency [SR]: Adoption of profitable agricultural technologies to improve N_r agronomic efficiency Adoption of wastewater treatment technology to improve the recovery of N_r from wastewater	Low efficiency of N in East African agriculture Low level of waste water N recovery in East Africa	Field trials in demonstration region (Yr 4): Increase N_r agronomic efficiency at scale by 20% of the baseline level in test plots shown Increase N_r recovery from wastewater by 10% of the baseline level in test plants shown	Reports from C3 Management Group	Known co-financing at selected demonstrations will allow field trials. Field trials in other demonstration areas will be subject to the availability of additional co-financing.

4.2 M&E

The project officer will be in charge of the project monitoring to ensure that all the data is centralized for ease of access and use for project reporting. The two project coordinators (main and associate) will evaluate the quality of the data in collaboration with the project consultant and SAG.

Timeline	Milestone	Leading role	Contributing role
By early Q1-Year 1	Project inception conducted	Project coordinators	Executing agency, DMG, SAG, selected key stakeholders
By end of Q1-Year 1	Stakeholder analysis completed	Project officer	DMG
By end of Q1-Year 1	Priorities areas identified	Project coordinators	Executing agency, DMG, SAG, selected key stakeholders
By end of Q1-Year 1	Demonstration strategy published and technologies of interest confirmed	Project coordinators	DMG & selected key stakeholders
By early Q2-Year 1	Best practices demonstrated at sentinel sites	Project officer	DMG & stakeholders
By Q3 of each year	Results of the demonstration discussed with the key stakeholders	Project coordinators	Executing agency, DMG, SAG, selected key stakeholders
By end of Q3 of Year 2	N flows assessment completed	ILRI, LVBC, LA-OMP, UGent	Project officer
By end of Q2 of Year 3	Major sources of uncertainties identified	ILRI, LVBC, LA-OMP, UGent	Project officer
By end of Q2 of Year 4	Data and information to reduce the uncertainties published	Project officer	ILRI, LVBC, LA-OMP, UGent
By Q3 of each year	Good practices for better N management published	Project officer	Executing agency, DMG, SAG, selected key stakeholders
By end of Q4 each year	Awareness of policy makers created and policy recommendations made	DMG & SAG	Executing agency, Key stakeholders
By end of Q4 each year	Awareness of key stakeholders created and best practices recommended	DMG	Executing agency, Key stakeholders, SAG
By end of Q2 of Year 4	Indicators of good N management in East Africa published	Project officer	Executing agency, DMG, SAG, selected key stakeholders
By end of Q3 of Year 4	Scenario for tracking	Project officer	Other demo sites,

	the indicators determined		executing agency, DMG, SAG, selected key stakeholders
By end of Q4 of each year	Annual report published including M&E data	Project officer	DMG
By end of Year 4	Final report published	Project officer	DMG
By end of Year 4	Project performance appraisal workshop held	Project coordinators	Executing agency, DMG, SAG, selected key stakeholders

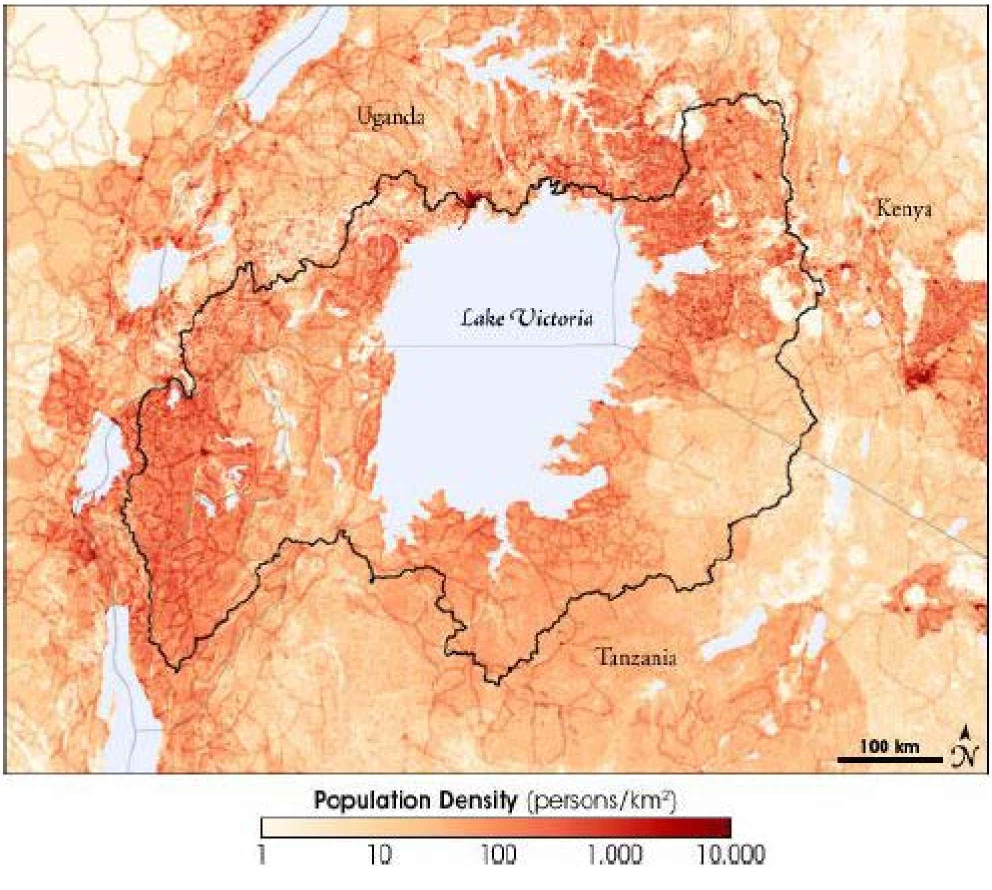
Annex 1: Terms of Reference for Partners / Key Consultants

Terms of Reference for the roles of Demonstration Project Co-ordinators and Project Officers along with potential consultants, is included in Appendix 11. The remit of these roles, along with decisions on the institutions and persons taking on these roles for each Demonstration Region, will be subject to endorsement by the Project Partners Assembly at the Inception meeting of the project.

Annex 2: East Africa Demonstration Site

Name of demonstration area: East Africa

Countries in the demonstration region: Burundi, Kenya, Rwanda, Tanzania, and Uganda.



Population around the Lake Victoria Basin LVEMP 2005 (Lake Victoria Basin Commission 2012)

Key nitrogen challenges for this region:

Most of the wastewater from the residential areas and the industry is discharged to water bodies without or with minimum treatment to remove nutrients such as nitrogen. Inadequate farming systems also contribute to N loading into the lake as a consequence of deforestation and encroachment to wetlands or other marginal lands because of population pressure. Recently, atmospheric N deposition has also been identified as a threat to the Lake. The current positive trend of fertilizers adoption is also expected to contribute to N loss to the environment. There is a need to assess the percent contribution of each source to N loading into the lake. Mitigation of N loss to the environment in the LVB will also require adequate assessment of the loss paths and strengthening policy interventions at the regional level.

Regional intergovernmental environment programme (ensuring a clear policy audience): Lake Victoria Basin Commission.

Which 'case' this demonstration activity supports:

Case 2: Challenges and opportunities for developing areas with insufficient N_r (too little N for production, two much losses into the atmosphere (e.g. greenhouse gases) and water bodies causing atmospheric deposition and eutrophication respectively. In addition, some aspects of the region refer apply to areas with too much nitrogen, with significant N pollution issues.

Existing regional/national N assessments or synthesis documents available

Hickman, J.E., Havlikova, M., Kroeze, C., Palm, C.A. (2011). Current and future nitrous oxide emissions from African agriculture. Current Opinion in Environmental Sustainability, 3, 370-378.
Leip, A., Leach, A., Musinguzi, P., Tumwesigye, T., Olupot, G., Tenywa, J.S., Mudiope, J., Hutton, O., Cordovil, C.M.D.S, Bekunda, M., Galloway, J. (2014). Nitrogen-neutrality: a step towards sustainability. Environmental research letters, 9, 1-10
Rufino, M.C., Brandt, P., Herrero, M., and Butterbach-Bahl, K. (2014). Reducing uncertainty in nitrogen budgets for African livestock systems. Environmental Research Letters, 9, 1-14
Zhou, M., Brandt, P., Pelster, D., Rufino, M.C., Robinson, T., Butterbach-Bahl, K. (2014). Regional nitrogen budget of the Lake Victoria Basin, East Africa: syntheses, uncertainties, and perspectives. Environmental resources letter, 9, 1-10

INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 17e (Activity 3.1e)

EAST EUROPE Demonstration

НОВА Енергія

1865

EPN-EECCA

Summary

The East Europe Demonstration Region occupies the territory of the Dniester, the Prut, the Lower Danube (from Prut to the Black sea) and the triangle area between the Dniester, Prut and lower Danube. The region links the Ukraine, Moldova and Romania. The key issues for this region is a general lack of reactive nitrogen (Nr) (in comparison to the 1980's), and increasing nitrogen pollution to freshwaters and marine systems. The efficacy of nitrogen management within the region has been impacted by political and technical problems, including legislation flaws, land-use violations, and poor management of water resources.

One of the core issues is nutrient accumulation in the Black Sea; the largest anaerobic isolated water basin in the world. Excess N and phosphorus (P) compounds are discharged from the three main rivers in its basin; the Danube, the Dnieper and the Dniester. All three rivers are transboundary: the Danube (19 countries), the Dniester (Ukraine, Moldova and Poland) and the Dnieper (Russia, Ukraine, Belarus). The main source of organic pollution to the rivers in the region is the discharge of untreated or partially treated wastewater from settlements, industry and agriculture. Ineffective soil management practice and excess fertiliser application, which often violates fertilizer application schemes, has resulted in leaching of N in runoff increasing N concentrations in surface waters.

The INMS project will provide an opportunity to increase awareness of these core issues and develop recommendations to reduce nutrient losses, for range of stakeholders including governmental organizations, private sector, academia, civil society organizations and UN agencies. Recommendations will be developed update current legislation (in Ukraine and Moldova) in line with the Water Framework Directive (WFD), Nitrate Directive (ND), Marine Strategy Framework Directive (MSFD). National policy should also be revised. It is necessary to develop guidelines, conventions and agreements that will govern all aspects concerning nutrient management and the health of the environment for the Dniester River Basin. This will build on past initiatives of the Global Environment Facility (GEF) related to the nutrients, and will enhance understanding of the connection between pollution of water, air and greenhouse gas emissions. The GEF (together with other donors) have a long history of supporting projects aimed at solving problems associated with excess nutrients and their impacts on coastal zones. This has been achieved through the implementation of transformation change management and practical demonstration projects. For example, projects which have involved 17 countries of the Danube/Black Sea Basins include: *The Black Sea Ecosystems Recovery Project (BSERP)* - a GEF Black Sea Regional capacity building and technical assistance element (in cooperation with the Black Sea Commission) under the leadership of UNDP; *The Danube Regional Project (DRP)* - a GEF Danube River Basin regional capacity building and technical assistance element. The Danube/Black Sea Basin Strategic Partnership on Nutrient Reduction also has a number of projects devoted to the preservation of biodiversity in the Lower Dniester. Main partners in this demonstration region will be: United Nations Economic Commission for Europe (UNECE), Brussels, Switzerland; Odessa National I. I. Mechnikov University (ONU), Odessa, Ukraine; Institute of Agroecology and Environmental Management of NAAS (IAEM), Kyiv, Ukraine (EPN-EECCA member); Chisinau, Moldova (potential partner); Bucharest Romania (potential partner). To achieve the main objectives of the project, *'to reduce the negative impact of reactive nitrogen on ecosystems and improve understanding of the global nitrogen cycle',* test management practices will be developed at the regional, national and local levels. In the Eastern European demonstration region all nitrogen flows will be considered so sources, paths and sinks can be quantified. Practical verification of scientific ideas and theoretical developments at the level of demonstration area will further confirm the scientific value and path ahead for the International Nitrogen Management System project.

Contents

Abbreviations

AQD ‘The Air Quality Directive’
ARI ‘Agrophysical Research Institute’
BS Convention ‘The Black Sea Commission’
BS Convention
CLRTAP ‘Convention on Long-Range Transboundary Air Pollution’
CPRD ‘The Convention on Co-operation for the Protection and Sustainable Use of the River Danube’
DC ‘The Danube Commission under CPRD’
DEF ‘Danube Environmental Forum’
DIN ‘Dissolved inorganic Nitrogen’
DON ‘Dissolved organic Nitrogen’
DPBMA ‘the Prut and Dniester River Basins, Dniester-Prut Basin Management Administration’
DRP ‘The Danube Regional Project’
DBSB ‘The Danube/Black Sea Basin Strategic Partnership on Nutrient Reduction’
ECLAIRE ‘Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems; EU FP7 project’
EMEP ‘European Monitoring and Evaluation Programme’
ENA ‘The European Nitrogen Assessment’
EPMAN ‘The Expert Panel on Mitigation of Agricultural Nitrogen
EPN-EECCA ‘The Expert Panel on Nitrogen for Eastern Europe, Caucasus and Central Asia Countries’
EU ‘The European Union’
EU-TACIS ‘European Union Technical Assistance for Commonwealth of Independent States’
GHG - Greenhouse gas
GP ‘Gothenburg Protocol’
HELCOM - Baltic Marine Environment Protection Commission
IAEM NAAS ‘Institute of Agroecology and Environmental management of National Academy of Agrarian Sciences’
ICPDR ‘The International Commission on Protection of the Danube River’
IEEP - Federal State Budget Scientific Institution “Institute for Engineering and Environmental Problems in Agricultural Production
INI ‘International Nitrogen Initiative’
IPCC - Intergovernmental Panel on Climate ChangeMD ‘Moldova’
INTAS ‘The International Association for the Promotion of Co-operation with Scientists from the New Independent States of the Former Soviet Union’
MOE ‘Ministry of Environment of Moldova’
MSFD ‘Marine Strategy Framework Directive’
ND ‘Nitrate Directive’
NE ‘NGO “New Energy”’
NECD ‘The National Emission Ceilings Directive’
NinE ‘Nitrogen in Europe’
NitroEurope ‘The nitrogen cycle and its influence on the European Greenhouse gas balance; EU FP6 project’
ONU ‘Odessa National I. I. Mechnikov University’
OSCE ‘The Organization for Security and Co-operation in Europe’
Ramsar convention ‘Convention on Wetlands of International Importance especially as Waterfowl Habitat’

RO ‘Romania’
SE ‘State Enterprise’
SRI ‘Scientific Research Institute for Atmospheric Air Protection’
Statistica.MD ‘Moldavian Statistics Service’
TN ‘Total Nitrogen’
TFRN ‘Task Force on Reactive Nitrogen’
UA ‘Ukraine’
UKRstat ‘Ukrainian Statistics Service’
UNDP ‘The United Nations Development Programme’
UNECE ‘The United Nation Economic Commission for Europe’
UNEP ‘The United Nations Environmental Programme’
USSGCC - State Service of Geodesy, Cartography and Cadaster of UkraineVNIIOU ‘Federal State Budget Scientific Institution “All-Russian Scientific Research Institute for Organic Fertilizers and Peat”’
WFD ‘The Water Framework Directive’

1 Introduction to the EAST EUROPE Demonstration in 'Towards INMS'

1.1 Background and Context

1.1.1 The regional problem

The East Europe Demonstration Region occupies the territory of the Dniester, the Prut, the Lower Danube (from Prut to the Black sea) and the triangle area between the Dniester, Prut and lower Danube. The region links the Ukraine, Moldova and Romania. The key issues for this region is a general lack of reactive nitrogen (Nr) (in comparison to the 1980's), and increasing nitrogen pollution to freshwaters and marine systems. The efficacy of nitrogen management within the region has been impacted by political and technical problems, including legislation flaws, land-use violations, and poor management of water resources.

During the last few decades, 'the nitrogen problem' has gained increasing attention in the European Union (EU). This has resulted in a number of EU based integrated research projects (e.g., NitroEurope, ECLAIRE), initiatives and programmes (e.g., NinE, INI, Our Nutrient World) as well as the first European Nitrogen Assessment (ENA). A number of directives (e.g., Water Framework Directive (WFD), Nitrate Directive (ND), Marine Strategy Framework Directive (MSFD), Air Quality Directive (AQD), National Emission Ceilings Directive (NECD) were developed and accepted. The European Monitoring and Evaluation Programme (EMEP) network under the Convention on Long-Range Transboundary Air Pollution (CLRTAP) has paid significant attention to N issues, and published regular open access assessments and reports on N emissions, transport and deposition. Many Eastern European countries (including the Republic of Moldova, Ukraine and Russia) ratified the CLRTAP convention, although the establishment of EMEP monitoring stations has been underwhelming, and monitoring is insufficient. As a result in Eastern Europe the identification of nitrogen issues and their solutions has significantly lagged behind other EU countries. The association agreements between the EU and the Ukraine and Republic of Moldova, provide hope that more systematic approaches to deal with nitrogen issues will be developed in the EU and actively implemented in Eastern European countries in the future.

1.1.2 Overview of the intervention and rationale

The common starting point for Eastern Europe countries (i.e. Romania and Bulgaria are within the EU and Moldova and Ukraine have signed association agreements) could be an establishment of regional N integrated monitoring network (e.g., in the framework of INMS initiative). This would span the Black Sea Basin (at least the North-Western part). A core issue in the region is nutrient accumulation in the Black Sea; discharged from the three main rivers in its basin; the Danube, the Dnieper and the Dniester. All three rivers are transboundary: the Danube (19 countries), the Dniester (Ukraine, Moldova and Poland) and Dnieper (Russia, Ukraine, Belarus). According to a recent assessment the environmental health of the Black Sea is worse than any other sea in Europe. The average riverine N load to the Black Sea has recently been estimated as 577 Gg N y-1 (Medinets, 2014). In spite of this, there is no national or international N management system in the region.

1.1.3 Atmospheric deposition

Atmospheric N deposition rates in the Lower Dniester Basin varied from 7.7 to 11.4 kg N ha^{-1} (60-65% as organic N) and represent an important source of N (especially when applied for entire basin area) (Medinets et al., 2014). According to the EMEP evaluation for 2012, the N deposition rates for the entire demonstration region were considered to be moderate. N deposition rates were 4-8 kg N ha^{-1} (1-2 kg N ha^{-1} of this was reduced N, and 2-6 kg N ha^{-1} was oxidized N).

The River Deltas are of special scientific interest due to their large wetland areas. The wetlands play a potentially significant role in N accumulation and N gases exchange, but are currently understudied. The wetlands are also affected by natural fires and acts of arson, resulting in regular cane burning. The N released by these events is also largely unknown.

1.1.4 Nature resources and agricultural sector

There are significant N issues related to agriculture, which accounts for almost two thirds of land use in the demonstration areas. Nitrogen pollution from surface run-off is significant but further assessment is required to accurately quantify loading rates (Moklyachuk at al., 2016; Moklyachuk at al., 2014). Poor land and livestock management is a leading cause of soil degradation throughout the region. In the Prut basin, agriculture dominates downstream sections of the river catchment (after the river exits the mountains). In these lowlands regions, the main N issue is associated with agricultural sector. In the Ukrainian part of the basin agriculture activity (cereals and industrial crops, garden faming, poultry and pig-farming) covers 20% of territory. Whilst in the Republic of Moldova farmlands occupy 76.8% of the area. Application of fertiliser is estimated to be 88 kg N ha^{-1} (30-40 kg N ha^{-1} in mountain areas) in the Ukraine, and 45 kg N ha^{-1} in Moldova. Due to limited data availability the estimates for organic fertilizer application are very preliminary. At the present time due to the unstable economic situation in region, the use of N fertilizer has declined.

The Danube is protected and managed by the the Danube Commission (DC) under The Convention on Co-operation for the Protection and Sustainable Use of the River Danube (also known as the Danube River Protection Convention or DRPC). In contrast, there are no such similar institutions or conventions to manage and protect the Dniester and the Dnieper. The Prut Basin and the Dniester Basin can be considered together since the catchments of these rivers share borders, i.e. in reality they connect to each other. There is a need for further research into N exchange processes in the interfluve between the Danube and Dniester Deltas, where a number of estuaries (the Shahany, the Alibei, the Burnas etc.) discharge into the Black Sea. These estuaries are considered together as one estuarine system (Sasyk - Shahany - Alibei - Burnas), and is internationally recognized under the Ramsar convention as an internationally important wetland for waterfowl. Despite DRPC coverage on this area, the main transboundary environmental problems are connected with poor water resource management and insufficient monitoring of water pollution. This is due to the lack of coordination and cooperation on water policy between Romania (an EU-member), the Ukraine and Moldova.

The Dniester is a transboundary river, which flows through three countries; starting in Poland (covering ~0.4% of its river basin), into Ukraine (totally ~72.6% of its river basin) and ending in Moldova (~27% of its river basin), before returning back into the Ukraine before discharging into the Black Sea (Annex 3, Fig.1). The river basin lies on 7 oblasts (administrative regions) of the Ukraine and on more than half the territory of Moldova (59%; of the 11 administrative regions and the Transdniestrian area) which borders the EU. The importance of the Dniester to South-Western part of Ukraine and Moldova is hard to overestimate, since it is the main source of both drinking and irrigation water for those regions. The lack of a working and joined up information management system for water resource management within the river basin is cause for concern. Currently, there are no monitoring of land-based pollution load (from agricultural and industrial activities), atmospheric pollution or assessment of environmental health. Because of this, environmental problems and impacts on human health of N pollution and modifications to water flow regimes are not being controlled. On top of this, there is increasing N (organic and mineral) pollution to the coastal waters of the Black Sea, in particular Odessa bay, which is exposed to excessive N loading via land-based hot-spots. The unresolved political status of the Transdniestrian region is another issue creating additional difficulties. Insufficient legislation base (both at the national and inter-governmental scale) for regulation and monitoring activities on that transboundary area provides a further and complex issue to resolve.

The Prut River is transboundary and its catchment covers 39% of Romania, 33% of Ukraine (two administrative regions) and 28% of Moldova territories (Annex 3, Fig.1). The Prut starts in the Mount Goverla and flows into the Danube. Groundwater of the Prut catchment is used in the Ukraine for household/drinking water supply (51.3%), agriculture (42.9%), industry (5.7%) and commercial bottling (0.1%). In Moldova ca. 21% is used for municipal purposes and ca. 17.6% is utilized for irrigation. In the Prut Catchment area there are five national parks, several nature reserves, one major wetland and several Ramsar-listed lakes (along the lower Prut). Environmental problems are similar to those highlighted for the Dniester River Basin. Additionally there has been a drastic increase in solid waste to landfill (covering ca. 529 ha in Moldova and ca. 67 ha in Ukraine), representing a potentially significant source of N pollution in the region.

The Dniester river catchment consists of rubbly soil in the mountain forests, soddy podzolic soil in foothills of Carpatians, grey forest soil in the Podol uplands and chornozem soil and podzolic soil in the lower areas. Chornozem soils are predominantly found in the Moldovan part of the Dniester Basin, which is dominated by agricultural land (76% agricultural land, of which 59% is arable). Agricultural land in the arid area of the Odessa region (Lower Dniester Basin) are composed of both black soils and chestnut soils. In total *c.* 67% of the Dniester Basin (in the Ukraine territory) is involved in agriculture activity (78% of this is arable). Mineral fertilizer application was estimated to be between 45 and 46 kg N ha^{-1} yr^{-1} within Odessa region, and 60 to 100 kg N ha^{-1} yr^{-1} within the republic of Moldova (organic and manure fertilizer and N content were not reported) (UKRstat, 2015; Statistica.MD, 2015). Whilst fertilizer application may be considered lower than many parts of the EU, there is variability between sites, and N retention and subsequent leaching is different for different soil types. A key concern is that poor soil management practice, and often inappropriate fertilizer application schemes (type of fertilizer, delivery method and timing of application) may cause N losses via atmospheric emission, leaching and surface runoff. An excessive use of pesticides in some areas is leading to declining soil quality, which may also increase N losses.

1.1.5 Industrial and municipal effluent discharge

The Ukrainian areas of Prut River Basin are agri-industrial, whilst the Moldovan areas are predominantly agrarian. Soils in the Prut Basin are brown mountain forest ruby soils, with tufty podzolic soils in the foothills, and dark grey soils changing to podzolic soils in the lower reaches. The basin experiences frequent flooding which threatens local populations and their economies and can be a cause of environmental pollution via surface run-off. One of the biggest environmental issues in the region is solid waste disposal. This has been dramatically increasing over last few decades. Currently, landfill covers 67 ha in Ukraine, and 529 ha in Moldova. The N losses from these landfills have not been assessed.

Eutrophication is also an issue in the region due to the discharge of untreated and partially treated wastewater to waterbodies. In both Moldova and Ukraine, wastewater treatment facilities have not been upgraded for 50-60 years. In the uplands the main N issue is caused by industry. In the Prut Basin, direct N emissions come from industries related to food production with indirect emissions from fuel combustion form mineral mining, industrial machine building and textiles industries. Widespread sand and gravel quarries are causing erosion and particulate matter pollution.

The poor state of wastewater treatment in the region may need to be considered as a separate task under INMS. It is noted that the reconstruction of waste treatment facilities in Odessa is planned with funding support from the World Bank and European institutions. Small harbors and cities located on the Black sea coast are potential hot-spot source of N pollution. There is also a requirement to address the regular fires/burning of canes in the river deltas that are currently leading to unmonitored N emission to the atmosphere.

1.1.6 Monitoring and evaluation

For the Eastern Europe demonstration region it is proposed that all the above-mention problematic areas (i.e. The Danube Delta, Prut and Dniester Basins, and the wetlands which discharge into the North-Western Black Sea) are included: (Annex 3, Fig. 1). We also propose to enhance the scale of investigation with collection of more detailed data for separate areas, such as the Lower Dniester Basin. With further experience our approach can be then applied to deltaic areas of other rivers in Eastern Europe.

1.1.7 Result of the interventions at both national and regional levels

Implementation of INMS will allow to: 1) improve land use management practice in order to increase N use efficiency within the region, 2) decrease atmospheric N emissions, 3) bring down N content in waste water discharged and mitigate N impacts on the Black Sea ecosystem.

1.1.8 Contributions to the INMS understanding/process

The East Europe demonstration region will focus on better understanding N flows within the region and identifying opportunities to improve N management across sectors. Areas of focus will include:

1. N delivery from municipal untreated, partially treated and treated waste water discharge into the rivers and the Black Sea
2. N delivered in surface run-off from agricultural lands
3. Atmospheric N emissions from wetland burning/fires
4. N interaction and exchange in wetlands (excluding burning and fire events)
5. Soil management practice

1.1.9 Relevance to national and regional policies

The proposed project will provide recommendations to participating countries on ways to improve their national legislation and policy, as well as development of new and/or amendment of existing transboundary agreements.

The Republic of Moldova and Black Sea countries (including Ukraine) have signed key ‘water resources-related’ conventions in that region; *The Convention on Co-operation for the Protection and Sustainable Use of the River Danube (CPRD)* and *The Convention on the Protection of the Black Sea against Pollution (BS convention) (excluding Moldova)*. Special attention is paid to the mitigation of eutrophication and nutrients discharge into the marine environment within these conventions. Although currently, Black Sea countries do not have any legislation and policy instrument for effective N management and regulation. That withstanding, the Nitrates Directive (ND) is in-line for new EU members from Black Sea region (Bulgaria and Romania) and is likely to extend to the

Ukraine, Moldova and Georgia, who have now signed association agreements with the EU. This is something that should be included in the INMS implementation road map.

Both countries (Ukraine and Moldova) have general laws for the protection of the natural environment; *“On Protection of the Natural Environment” (1991)* in the Ukraine, and *“On Environment Protection” (1993)* in Moldova. These laws have an agenda to, protect human health, plants and animals, harmonize the interaction between society and nature, and promote sustainable management of natural resources.
The following list of bi-lateral and three-lateral agreements covering parts of the demonstration area, have been signed between Romania, Moldova and Ukraine during last decade:

- Agreement between the Government of Romania and the Government of the Republic of Moldova with Regard to the Cooperation in the Area of Protection of Fish Resources and the Regulating of Fishing in the Prut River and Stanca-Costesti Artificial Lake (Stanca-Costesti, 2003);
- Agreement for the Establishment and Management of a Cross-Border Protected Area between the Republic of Moldova, Romania and Ukraine in the Danube Delta and the Lower Prut Nature Protected Areas (Bucharest, 2000);
- Agreement between the Government of the Republic of Moldova and the Government of Ukraine on Joint Use and Protection of Transboundary Waters (Chisinau, 1994);
- Agreement between the Government of Romania and the Government of the Republic of Moldova on Cooperation for Protection and Sustainable Use of Water Resources of the Danube and the Prut (Chisinau, 2010);
- Regulation of water quality monitoring of the Prut River within the framework of bilateral cooperation between Romania and the Republic of Moldova (1992);
- Agreement between the Government of the Republic of Moldova and the Government of Ukraine on Joint Use and Protection of Transboundary Waters (1994);
- Agreement on scientific-technical cooperation between the Head Office of the State Department of Hydrometeorology of the Republic of Moldova and the State Committee for Hydrometeorology of Ukraine (1994);
- The Agreement between the Government of Romania and the Government of Ukraine on Cooperation in the Field of Transboundary Water Management is implemented through Plenipotentiaries (1997);
- Regulation on cooperation between Moldova and Ukraine on trans-boundary water monitoring, concluded during the 14th Meeting of Plenipotentiaries on implementation of the 1994 Agreement of the Government of the Republic of Moldova and the Government of Ukraine (Costesti, 2012).

However most of agreements covering water management, focus on flood risk issues only. It is understood that established cooperation mechanisms have to be revised according to UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes and the EU Water Framework Directive (since Romania is an EU-member and both Ukraine and the Republic of Moldova have signed Association Agreements with EU, but aim to become members of the EU in future).

1.1.10 Relevance to national and regional policies

The republic of Moldova, Ukraine and Romania have signed/ratified a list of international conventions and protocols regarding conservation of biodiversity, water resources and air pollution which are indirectly related to N issue in the demonstration region (Table A17e1).

Table A17e1: *International treaties related to the demonstration region signed and ratified by Ukraine, Moldova and Romania ("+" – ratified; "-" – non-ratified)*

Convention/protocol/declaration	Ukraine	Moldova	Romania
Convention on Long-Range Transboundary Air Pollution	+	+	+
Convention on the Protection and Use of Transboundary Watercourses and International Lakes, including:	+	+	+
Protocol on Water and Health	+	+	+
Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters	signed	signed	+
Convention for the Internationally Important Wetlands Especially as Waterfowl Habitats	+	+	+
Convention on Biological Diversity	+	+	+
Convention on the Protection of the Black Sea against Pollution	+	-	+
Convention on Protection of Wild Flora and Fauna and Their Habitats in Europe	+	+	+
Convention on the Conservation of Migrating Species of Wild Animals	+	+	+
Convention on the Transboundary Effects of Industrial Accidents	-	+	+
Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, including:	+	+	+
Protocol on Emission Inventories	signed	signed	+
UN Declaration on Environment and Development	signed	signed	signed
Convention on the Environmental Impact Assessment in a Transboundary Context, including:	+	+	+
Protocol on Strategic Environmental Assessment	signed	signed	+
Stockholm Convention on Persistent Organic Pollutants	+	+	+
The Convention on Co-operation for the Protection and Sustainable Use of the River Danube	+	+	+

1.2 Environmental threats, root causes and barrier analysis

1.2.1 Description of the sources, pathways and impacts of N

Surface run-off, discharge of domestic wastes, discharge from livestock farms and industry and municipal wastewaters are the core sources of organic N within the region.

Atmospheric deposition of N has recently been identified as an additional and significant source of organic N to the Dniester River Basin (with average deposition of 7.7 kg N ha^{-1}) (Medinets et al., 2015).

The average soil NO_x emissions assessed by the EU FP7 ECLAIRE project did not include N emitted by wetland cane combustion, which is potentially a significant N source. Eutrophication and acidification associated with biodiversity loss are key environmental threats related to excessive N.

High emissions of N_2O from N saturated waterbodies are expected (Durand et al., 2011) although field measurements have not been carried out in the Dniester, or the Lower Danube. Additionally, N gases exchange in wetlands has not been studied for that region. Although arable lands located in river basin are associated with GHG (e.g., N_2O) and reactive N (NH_3, NO_x) emissions (Medinets et al., 2014, 2015).

Surface runoff from agricultural land has contributed significantly to total N pollution loading to waterbodies. Recent assessments (OSCE/UNECE, 2005-2014) have shown that the Dniester's ecosystem is overstressed due to intensive agriculture. The average total N (TN) flow from the Dniester River to Dniester Estuary is 36.6 (±25.7) Gg N y^{-1} (46% of mineral N and 54% of organic N) for 2010-2013 (Medinets et al., 2015). While historical data (2003-2005) regarding Danube N load observed dissolved inorganic N (DIN) flow to the Black Sea was 362.6 Gg N y^{-1} (TDA, 2007; BSC, 2008); ten times as much as TN from the Dniester.

1.2.2 What has prevented N management being addressed in the region before

Difficulties in cooperation at an international level, associated with different (often weak) national legislation have hindered progress in improving N management. A lack of financial support has also played a role. The situation in the Dniester region is additionally complicated due to the Transdniestrian conflict. Furthermore, currently there is little direct dialog between land and water resources users and policymakers.

Currently there is an absence of any N management system at a government level (laws, directives etc.) for the Dniester river basin. Furthermore, the Prut Basin and the Lower Danube region (as parts of the Danube River Basin) are included in the CPRD, but still has no N-related directive implemented relating to its management (Moldovian and Ukrainian areas). National standards, in terms of N content (threshold allowable concentrations) for water, soil, air and food are needed. Encouragingly, in the last few decades important steps in cooperation between the Ukraine, the Republic of Moldova and Romania on the joint use, management and protection of river waters have resulted in a number of bi- and three-lateral agreements (listed above). These may be further amended in the future, to include N management.

1.3 Institutional, sectoral and policy context

1.3.1 The main organisations (government and others) involved in N related issues

There are governmental organizations within each oblast (administrative region of Ukraine) responsible for monitoring N concentration in rivers (i.e. State Ecological Inspection, Health Inspection Service, State Hydrometeorological Service), drinking water (i.e. Health Inspection Service), soil (i.e. State Ecological Inspection, State Hydrometeorological Service, Ukraine Soil Fertility Service), the atmosphere (i.e. State Hydrometeorological Service) and food (Health Inspection Service, State Veterinary Service, Plant Quarantine Service) and land-use (State Service of Geodesy, Cartography and Cadastre of Ukraine).

In the Prut and Dniester River Basins, the Dniester-Prut Basin Management Administration (DPBMA) responsible for implementing State policy relating to the management, use, protection, regeneration, and development of water resources, and the management of water facilities and waterworks. DPBMA coordinate the activities of institutions on issues of providing water resources to the population and industry within the basins, under the State Agency for Water Resources of Ukraine (SAWR).

The Ministry of Environment of Moldova (MOE) is the responsible authority for the development and improvement of river basin management plans. Its agencies include:

- The “Apele Moldovei” and State Enterprise (SE) “Basin Water Management Authority”, responsible for surface water resources management,
- The Agency for Geology and Mineral Resources, responsible for groundwater resources management, SE “Hydrogeological Expedition of Moldova” under MOE and responsible for groundwater monitoring,
- The State Hydrometeorological Service, responsible for surface water monitoring,
- The State Environmental Inspectorate of MOE, responsible for controlling pollution sources,
- The National Centre of Public Health and Local Public Health Centers of the Moldovan Ministry of Health, which are responsible for water quality monitoring.

In terms of Romania, since it is already an EU-member, policy for the Protection of the Environment must be in-line with EU legislation (e.g., WFD, ND etc.).

Many scientists in Ukraine have been involved in environment protection and safety programmes during last few decades. For example, Odessa National I. I. Mechnikov University have carried N (both organic and mineral) monitoring of waters, soil and air in the Dniester Basin. Those activities were performed under INTAS/EU-TACIS projects (2005-2007), EU FP6/FP7 projects (2006-present) and national environmental programs (2010-present). Members of the National Academy of Science of the Ukraine, National Academy of Agriculturalarian Science of Ukraine, study different aspects of nutrition in farming, plant and animal breeding. The Institute of Agroecology and Environmental Management (IAEM) is involved in the following research programmes:

- Study of microbial N fixation in the soil and the development of biological products based on N fixing bacteria
- Evaluation of the degree of soil organic matter degradation

- Assessment of carbon stock change in pools of mineral soils based on calculation of balance N-flows from Cropland and Grassland
- Assessment of the impact of livestock farms on the environment
- Impacts of climate change on agricultural production
- Adaptation strategy of agriculture development to conditions of climate change

From 2016 to 2020, IAEM plan to conduct the following national projects:

- To develop the scientific basis of minimizing the emission of nitrous oxide and ammonia from agricultural sources in accordance with the EU Common Agricultural Policy. State Registration number 0116U000702
- 'To develop scientific bases of rehabilitation of contaminated soil to improve the safety of agro-ecosystems within the concept of the UNEP "Global Green Growth". State Registration number 0116U000491
- To develop the scientific basis of environmental assessment of agrobioresources in Climate Change conditions. State Registration number 0116U000703
- To develop Guidelines for the prevention and reduction of emissions of ammonia from agricultural sources. State Registration number 0116U000704
- To develop scientific and practical principles of low-carbon development of agricultural production in Ukraine. State Registration number 011U003310

1.3.2 Main private sector organisations (industry, farmers, etc.) and where N is used and produced

The main N users in the demonstration region are big and middle-size agricultural enterprises, cooperatives, holdings as well as many small-sized private farms.

Within the demonstration region there are numerous industries that can be considered both N producers and N users. These include:

- Industrial machine building enterprises for oil and gas processing equipment (more than 16 large enterprises; e.g., UCM Prut-80),
- Industrial wood processing and construction materials industries,
- Ship management and repair companies (“Black Sea Shipping Company”, “Ukrainian Danube Shipping Company”, “Ukrferri”, “Ukrtanker”, Ismail Shipyard, "DunaySudnoServis”, "Etalon", Ismail Oil Extraction Plant),
- Food industries (more than 60 enterprises; meat, sugar (e.g., Sudzucker Moldova), bread and baked goods, confectionery, beverages, milk products, fats, vegetables and fruits).

In 2003 in Moldova, the Ungheni Business Free Economic Zone for industrial production of export goods, processing of transit good, foreign trade and related services there was established. The most recent data (2012) stated 38 companies were registered in that zone.

In Western Ukraine, modernization of technologies for processing and production of animal products by many companies (e.g. Kolos Corporation, Ukrainian Food Group Ltd, Tarasovetsky Broiler Building Ltd, Bukovina’s meat state enterprise etc.) and the construction and implementation of new animal breeding facilities (turkey-rearing, pig-breeding, poultry-breeding, cow-keeping complexes and milking halls) has increased livestock production. In contrast, in Moldova livestock production has decreased due to frequent droughts and the absence of financial subsidies. Romania has also experienced a decline in the agricultural sector, but due to subsidies and supporting programmes within the EU, this situation is improving.

1.3.3 What national policies are in-place / planned

A number of national policies are in place which have relevance to N management.

In the Ukraine national policies with relevance to N management include:

- The law "On Protection of the Natural Environment" (1991), which aims to protect and maintain a natural environment that is safe for plant and animal life, protect human life and health against the adverse impacts of environmental pollution, achieve a sustainable relationship between society and nature, sustainable management of natural resources.
- The "Main Directions of the National Policy of Ukraine in the Field of Environment Protection, Nature Resource Use and Environmental Safety" (1998) have been established and emphasize maintenance and operation of existing wastewater treatment facilities, proper sanitation in urban areas, strengthening the powers of environmental authorities, enforcement of legislation relating to the management regime of water and coastal protection zones, and control over storage and application of pesticides, mineral fertilizers and oil products.
- The Law "On approval of the National Programme of Protection and Rehabilitation of the Azov and Black Seas" aims to protect the Black Sea and the Sea of Azov against pollution.
- The Law "On air protection" aims to protect ambient air against pollution, and regulate emissions of harmful substances from industry and transport;
- The Law "On state control over land use and protection" aims to protect natural soil resources.

In the Republic of Moldova national policies with relevance to N management include:

- The law "On Environmental Protection" (1993) defines the main principles of environmental management and protection as the country's top priority, with a focus on human health and safety, economic and societal interests and the country's long-term sustainable development;
- In 'unresolved status of the Transdniestrian region' a number of regional regulations for the protection of the environment and sustainable management of natural resources have been adopted.

In Romania national policies with relevance to N management include:

All EU, ratified conventions and directives (e.g., WFD, ND, MSFD etc).

There are also a number of Bi- and three-lateral agreements between the Governments of Ukraine, the Republic of Moldova, and Romania, on the joint use, management and protection of river waters (fully listed above). These agreement need to be revised to reflect modern political aspirations within the region (i.e. 'striving to achieve EU standards'). The Ukraine and Moldova improving national legislations to achieve EU standards, for further implementation of WFD, ND and MSFW.

1.3.4 NGO and CSO activities

Non-governmental organizations (NGO) and civil society organization (CSO) are active throughout the demonstration region. Although there are no NGOs and CSOs working to address the N problem specifically, there are more than 51 NGOs from Moldova and the Ukraine working to improve the ecological status, biodiversity of the water basins.

The International Commission on the Protection of the Danube River (ICPDR) was created in 1999 by the Danube Environmental Forum (DEF). It is the main platform for non-governmental, non-profit, politically independent environmental organizations within the Danube River Basin.

2 Baseline for the EAST EUROPE Demonstration in 'Towards INMS'

2.1 Baseline analysis

2.1.1 Previous work that is relevant to the work of this project

In the last few decades a number of projects conducted in the region have had relevance to the INMS project (Annex 1, Table 1). Since 2005, Odessa National I. I. Mechnikov University (ONU), has conducted research to investigate N interactions between soil, water and air in the region. These projects include:

- EU-TACIS Project, *Lower Danube Lakes: Sustainable Restoration and Protection of Habitats and Ecosystems,* (2000-2003)
- INTAS Project, *Development of New Methods to Process Information about the Quality of Water in River Basins,* (2005-2007)
- EU-TACIS Project, *Technical Assistance for the Lower Dniester Basin Management Planning,* (2006-2007)

Other relevant work includes:

- The EU FP6 project, *Nitrogen Cycle and its Influence on the Greenhouse Gases Balance in Europe* (NitroEurope; 2006-2011) where a number of parameters (i.e. mineral and organic N content in soil; N mineralization and nitrification rates; soil-atmosphere N_2O and NH_3 exchange; N gases and aerosols concentrations; atmospheric N deposition; N-fertilizer application) were continuously monitored.
- Current EU FP7 project, *Effects of Climate Change on Air Pollution and Response Strategies for European Ecosystems* (ECLAIRE; 2011-present) with a focus on reactive N species. This project supported the ONU to conduct long-term measurements of soil-atmosphere NOx exchange, in arable land typical to the demonstration region.

National Ukrainian N-related projects include coordinated by ONU:

- Complex investigations and determination of conditions for eutrophication's effects in the Dniester Delta (2009-2010);
- Study of the content and input of atmospheric fluxes and nutrient balance of the Lower Dniester river basin (2011-2012);

- Assessment of the impacts and greenhouse gases emissions of agro-industrial activities and fires on the Lower Dniester ecosystems (2013-2014);
- Study of the state of typical water bodies in the Black Sea area to enhance scientific and methodological recommendations for future environmental monitoring (2015-present).

The ONU has a permanent research station, "Petrodolinskoe", and three sites that conduct continuous atmospheric deposition collection and river water sampling in the Lower Dniester basin. The IAEM has also been involved in the Ministry of Ecology and Natural Resources of Ukraine coordinated project, *Drafting Rules of good agricultural practices*. This project contributes to the reduction of emissions of ammonia and biogas utilization and actively participated in the GHG Inventory Report preparation covering the 2005 – 2012 period.

2.1.2 Relevant activities undertaken to 'manage' N

Unfortunately, no direct actions have been made to 'manage' N within the demonstration region. Only short and long-term monitoring of various N-compounds in water, soil and air have been carried out to study dynamics and estimate impacts. However those studies can be used as knowledge base to develop future N management in the region.

2.1.3 GEF actions

The Global Environmental Facility (GEF) is widely involved in the Black Sea ecosystem research and monitoring activities and are summarized in Table A17e2.

Table A17e2: *GEF actions related to Eastern Europe demonstration region area.*

Projects	Countries
The Black Sea ecosystem recovery project (BSERP): control of eutrophication, hazardous substances and related measures for rehabilitating the Black Sea ecosystem	17 countries of the Danube/Black Sea Basins
The Danube Regional Project (DRP)	17 countries of the Danube/Black Sea Basins
Danube/Black Sea Basin Strategic Partnership on Nutrient Reduction (DBSB)	17 countries of the Danube/Black Sea Basins
Strengthening governance and financial sustainability of the national protected area system in Ukraine	Ukraine
DBSB Agricultural Pollution Control Project (under WB-GEF Strategic Partnership for Nutrient Reduction in the Danube River and Black Sea)	Moldova
Danube Delta Biodiversity	Ukraine
Pilot Projects for Promoting Best Agricultural Practice in the Central and Lower Danube River Basin Countries: Concept and Project Proposals	Moldova, Romania, Ukraine
Promoting best agricultural practices to reduce pollution generated from farming in the Lower Danube	Romania
Water Quality Management and Conservation of Biodiversity in the Lower Dniester	Moldova, Ukraine
Biodiversity Conservation in the Lower Dniester Delta Ecosystem	Moldova
Improving Environmental Monitoring in the Black Sea (EMBLAS I)	Ukraine, Georgia, Russia
Improving Environmental Monitoring in the Black Sea (EMBLAS II)	Ukraine, Georgia, Russia

2.1.4 Other donors

The main donor organizations which has been involved in various activities concerning research, management and policy in the Dniester River Basin are EU-TACIS, OSCE, UNECE as well as various foundations (e.g., Rosa Luxemburg Foundation, Germany and The Black Sea Development Foundation, USA).

2.1.5 Nationally funded

A number of Ukrainian national ‘low-cost’ projects are currently underway to monitor and study the Low Dniester River ecosystem, mainly triggered by ONU (as the coordinating partner) and leading on from the EU-TACIS and EU FP6/FP7 projects (Table A17e3).

In the Danube Basin, the Ministry of Environment of Ukraine conduct a number of ‘low-cost’ projects with the participation of the Odessa Regional State Administration and other regional stakeholders (Table A17e3). There were also numerous projects covering the entire territory of the Ukraine (including demonstration area) under the Ministry of Ecology and Natural Resources of Ukraine research program (e.g., drafting rules of good agricultural practices, which contribute to the reduction of ammonia and biogas emissions.)

Table A17e3: *Examples of national projects covering demonstration region area*

Project	Duration
Integrated investigations and determination of conditions for eutrophication in the Dniester Delta (Ukraine)	2009 - 2010
Study of the content and input of atmospheric fluxes into the nutrient balance of Lower Dniester river basin (Ukraine)	2011 - 2012
Assessing impacts of agro-industrial activities and fires on the Lower Dniester ecosystems and greenhouse gases emissions (Ukraine)	2013 - 2014
Assessment of the state water bodies connecting to the Black Sea region, to make recommendations for improvement to environmental monitoring regimes (Ukraine)	2015 - 2016
Development of the National Ecological Network of Moldova as part of the Pan-European Ecological Network, with an emphasis on international cooperation (Moldova)	2009 - 2012
Improved water management and protection of ecosystems in the Ramsar site ("Lower Dniester" Moldova)	2012 - 2014
Implementation of the CITES recommendations for the Ukraine in order to better control and manage sturgeon populations in the Lower Danube and north-western Black Sea.	2011 – 2012
Preparation of information on the implementation of “The Program for the Complex Development of the Ukrainian Danube Region” of Ministry of ecology and natural resources of Ukraine for 2004-2011	2004 – 2011
Technical Assistance to improve navigation conditions in the joint Romanian-Bulgarian Danube sector with additional research	2011 - 2012
Conducting research in order to prepare plans for river basins management of the Dniester, Prut and Siret	2012

2.1.6 Planned work that will contribute to the baseline

Planned works include that will contribute to a baseline understanding include:

- Quantification of the main N flows,
- Characterization of main source sectors,
- Improvement to access and understanding of data availability,
- Assessment of the fate of N flows,
- Analysis of N threats and benefits and priorities,
- Assessment of N performance indicators,
- Review of possible mitigation and management options via scenario development.

In particular, ONU is currently working on characterization of the main N flows in the demonstration region, including the Dniester Basin and interfluve area and the Black Sea. Preliminary assessments of N budgets for the region are written into the framework of a number of Ukrainian national projects. ONU staff working on these projects will be able to contribute to a review of available for mitigation/better N management options. The results of ONU's Ukrainian national projects will also contribute in part to global scenario development analysis.

As a result of competition which was held by the Academy of Sciences of Ukraine, IAEM received grants from the budget of Ukraine to perform three fundamental and one applied projects in 2016 - 2020. Fundamental research includes development of a scientific basis for minimization emissions of reactive nitrogen from agricultural sources and development of measures for the mitigation of Climate Change. This will be based on UNECE Framework Code in 2016. Draft Guidelines for good agricultural practices, will contribute to the reduction of ammonia emission from agricultural sources.

2.2 Gaps

2.2.1 Main gaps in the region with respect N policies

As previously described Ukraine and Moldova have general laws for the protection of the environment, however no specific directives or protocols regarding N management exist. Regular monitoring of a limited number of N species (in fact, threshold allowable concentration determination) is stipulated under these laws, in order to inform regional governments and the general public about the health of the environment. However, currently there is no integrated approach, analysis or common database for N content in air, soil and water. A significant and unregulated issue is biomass combustion (especially in the wetlands), which needs to be regulated.

There is no common understanding and real use of good management practice in the demonstration region. Due to the current economic situation (Moldova and Ukraine) and peculiarity of the land-use scheme (Ukraine: land belongs to government and can be leased only) each agricultural enterprise, large collective farm or smallholder farmer uses their own approaches based on mainly economically feasible aspects to spend less investment in an 'effective' way (e.g., using cheap fertilizers and 'dirty' pesticides) and get more profit (competitive products) often neglecting the long-term negative consequences on the state of the environment (including cultivated soil). On the other hand there is some willingness for by farmers to manage their business in sustainable way to provide a 'healthy' soil for future generations, although often they need to revise their intentions to fit with the economic reality. An example of bad management practice which is still common is plant residues (in the field) and cane (in wetlands) burning as well as plastic drip irrigation tapes and solid litter combustion. Noteworthy, in the southern part of the demonstration region, the arid region, water is the resource most in demand and most expensive for agriculture (and even for drinking in several districts in the Lower Danube). Sometimes water is only available to farmers when they pay in advance on a monthly basis. The latter is a very problematic issue due to an absence of credit facilities for farmers in Ukraine. In Moldova, frequent drought events and the lack of subsidies has caused a significant slump of animal farming.

At the present time separate fundamental processes of the N cycle are well investigated in general. Although there is scientific knowledge related to N led development of good management practice approaches, it is in practice hard to implement in many regions. In many cases the people working with the relevant legislation behind are not ready or able to understand it and accept it. The entire ecosystem (e.g., the Dniester River Basin) is a very complicated 'organism', where it is not easy to determine the contribution of separate sources and sinks to/from the whole area and even more complicated to understand the interaction between those components and characterize their influence on taking into account adaptation and alteration of biota to 'new' living conditions.

During the project we will investigate the following important aspects in the study region; quantification of the main N flows and source sectors, consideration of the fate of the N flows, estimation of N performance indicators, description of mitigation options, recommendation of best management practices for the region.

The main gaps in this region are associated with: 1) surface run-off, 2) wetland N exchange, 3) cane burning in wetland, 4) biomass burning, 5) litter burning, 4) waste water discharge, 5) N leaching, 6) N emission from waterbodies, 7) N buried in sediments, 8) areas of land-use owners and types of land-use.

According to the planned budget for the Eastern Europe demonstration region, $270k of core INMS finding plus $671k co-financing is available, at least half of this budget should be spent on addresses gaps and barriers to change.

In fact, under the current complicated situation in the Ukraine regarding governmental budgets for national research, social and policy-related projects in the region are scarce. The only possible and effective way to fill the gaps in our knowledge, change the barriers between users of basin resources and policymakers, improve social understanding of N problem is via international research and policy projects and initiatives such as GEF, UNEP, UNDP, ENECE, TACIS, OSCE, research and social foundations etc.

2.3 Stakeholder analysis

The main N users are large and middle-size agricultural enterprises, cooperatives, holdings and many small-size private farms in the region. The main N producers are N fertilizer production companies, livestock and poultry enterprises and small farms, industrial enterprises and small private producers (in terms of N saturated waste water), agricultural farms (in terms of N emission),), big and middle-size agricultural enterprises (in terms of N emission as a result of manure and N-fertilities input in agriculture soils).

The end of chain users and emitters could be considered as, municipalities of big cities and regional administrations which are responsible for waste treatment as well as the administrative functions of the National Parks and National Biosphere Reserves are responsible for biomass burning and fires in wetlands.

The main stakeholders are civil society, industry, such as fertilizer manufacturers, farmers, municipalities, regional and local administrations, water resource users and the scientific community.

The role of government in N management in the regions is indirect through national legislation only in Moldova and Ukraine. This is via the following laws; “On Protection of the Natural Environment”, “Main Directions of the National Policy of Ukraine in the Field of Environment Protection, Nature Resource Use and Environmental Safety” , “On approval of the National Programme of Protection and Rehabilitation of the Azov and Black Seas”, “On air protection”, “On state control over land use and protection”. Since Romania is an EU-member, the main conventions and N-related directives (WFD, ND, MSFD etc.) principles have to be implemented as soon as possible as they have not been implemented yet.

Farmers (horticulture, livestock and poultry), water resource users and small business representatives play a significant role in the region and are potentially important stakeholders who are directly involved in N management as both N producers and users

There are many NGOs in the region, which have rather active social positions regarding the River Basin management. They are interested in improvement of the state of the environment in terms of biodiversity protection and restoration

3 Project Description for the EAST EUROPE Demonstration in INMS

3.1 Strategy

3.1.1 General Information

The work plan described in this Appendix forms part of the overall execution of INMS Component 3 on the Regional Demonstration of the Full Nitrogen Approach. The rationale for this broader approach is described in Appendix 17. The development of a common strategy to all the Regional Demonstrations in INMS is an iterative process and has already benefited from three workshops connected with the PPG Phase. This strategy aims to a) provide sufficient common approach to allow comparability between the different regional demonstrations, especially when synthesizing and applying the results (Activities 3.2-3.4; Activities 2.2-2.4), b) provide sufficient scope to allow regional priorities to be addressed according to the different regional needs.

3.1.2 Consistency and relevance to national and regional policies/priorities

As outlined elsewhere in this document, the consequences of misuse of natural resources (water and land) and waste treatment discharge from domestic and industry sectors in the transboundary River Basins (the Dniester and the Danube) has national, regional and global impacts. The causes are due to both a lack of regulation in some parts of the region (for example non-EU countries) and due to insufficient legislation (on national and intergovernmental levels) in other areas. Better implementation of existing policies such as the Water Framework Directive (WFD), Nitrate Directive (ND), Marine Strategy Framework Directive (MSFD) and the Gothenburg Protocol (GP) is needed. In working to address this, the demonstration activity will act as a source of information to inform current policies in the region, share best practice that already exists and to encourage the development of more effective policies and strategies to manage nitrogen in this region. Existing efforts for the Danube and the Black Sea Convention could be applied for example to improve the management of the Dniester River. To facilitate this, during the initial phase of the project, engagement will take place with regional/national groups who are concerned with Framework Directive (WFD), Nitrate Directive (ND), Marine Strategy Framework Directive (MSFD), also the Danube Basin River Commission and the Black Sea Commission to widen the stakeholder base of the project to provide key contacts in a range of relevant policy bodies in the region. Results from other groups will be utilised, to enable a full assessment, including both river basins and the sea.

The Expert Panel on Nitrogen in Eastern Europe, Central Caucasus and Asia (EPN-EECCA) will play a key role in the activities of the demonstration. This panel sits under the Task Force on Reactive Nitrogen, which reports to the Working Group on Strategies and Review of the UNECE Convention on Long Range Transboundary Air Pollution. As such, the group has expertise in the emission of ammonia in agricultural settings, in an Eastern European context (and has contributed to a number of adopted documents and workshop proceedings etc), however the group has the wider remit of considering the whole nitrogen cycle in an EECCA context. The demonstration activity will be able to both tap into the current expertise of the group and to strengthen its activities in looking at the nitrogen cycle in the wider context. Several of the partners in the demonstration activity are also partners in the EPN-EECCA group (see below) and the UNECE Secretariat is also a partner in the project.

On a national level, the demonstration activity will also strive to develop close links with work on the Ukrainian ‘National Action Plan on Environmental Protection’, which supports the law ‘On the General Principles (Strategy) of the State Environmental Policy of Ukraine till 2020’. The National Action Plan for 2016-2020 is currently under revision, therefore the work of the demonstration would aim to feed into future updates of this National Action Plan.

Environmental policy in the Odessa region is based on the ‘State Environmental Policy of Ukraine till 2020’, through a number of programmes which link with the nitrogen issue:

- Regional program for the treatment of toxic waste in the Odessa region for 2008-2015;
- The program of developing national ecological network in the Odessa region for 2005-2015;
- Regional program for the conservation and restoration of water resources in the basin of Kuyal'nitskiy firth for 2012-2016;
- Regional Program "Forests of Odessa region" in 2011-2016 years;
- Regional program for construction, reconstruction and modernization of the infrastructure of Odessa region for 2012-2015.

Engagement with these programs will be beneficial and results from the demonstration activity may be able to inform the future phases of these programmes.

3.1.3 Partners

Partners for case 3: Nitrogen challenges for transition economies			
R25	**Others**	**Science and Practices**	**Odessa National I. I. Mechnikov University (ONU), Ukraine**
R26	**Others**	**Science and Practices**	**Institute of agroecology and environmental management of National Academy of Agrarian Sciences (IAEM), Ukraine**
R27	**Non-ministry public body**	**Science and Practices**	**Federal State Budget Scientific Institution "Institute for Engineering and Environmental Problems in Agricultural Production" (IEEP), Russia**
R28	**Non-ministry public body**	**Science and Practices**	**Federal State Budget Scientific Institution "All-Russian Scientific Research Institute for Organic Fertilizers and Peat" (VNIIOU), Russia**
R29	**Others**	**Science Support**	**Scientific Research Institute for Atmospheric Air Protection (SRI), Russia**
R30	**Multilateral Agency**	**Policy and Practices Support**	**Commission on the Protection of the Black Sea Against Pollution (BSC PS), Turkey**
S1	**Civil Society Organisation**	**Policy and Dissemination**	**Non-Governmental Organisation ' New Energy' (NGO-New Energy), Ukraine**

We aim to engage with the following groups during the project, to enlist them as partners:

- Odessa Regional State Administration
- State Department of Environmental Protection in the Odessa region
- Departament (Administration) of Natural Resources of Regional Council
- Odessa Regional Department of Statistics
- Odessa Regional Department of State Service of Geodesy, Cartography and Cadaster
- Odessa Regional Department of Water Resources
- Odessa Regional Department of Forestry and Hunting
- Main Department of State Soil Agency in the Odessa region
- State Environmental Inspection in Odessa region
- The State Inspection of agriculture in the Odessa region
- City councils of Kiliya, Reni and Izmail.

3.1.4 Outputs and activities

The work of this demonstration will support Output 3.1: A demonstration activity which delivers conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing: Case 3: Regions with transition economies. This demonstration area is the only one to address Case 3 and will take into account the challenges posed by this situation. Figure A17e1, shows the work of Activity 3.1, which directly supports delivery of Outcome 3.1 in each of the demonstration region. Activity 3.1 contains a number of tasks (described in more detail in Section 3.2) and are as follows:

- **Task 3.1.1 & 3.1.2:** Examination of N flows by source sector & loss pathway; inc improving access to data
- **Task 3.1.3:** Identifying & quantifying major uncertainties and means to improve
- **Task 3.1.4 & 3.1.5:** Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA
- **Task 3.1.6:** Description in relation to N performance indicators, in co-operation with global analysis
- **Task 3.1.7:** Review of available options for mitigation/better N management, co-benefits/trade-offs
- **Task 3.1.8:** Profiling success stories, barriers to change, and demonstration of N joined up approach

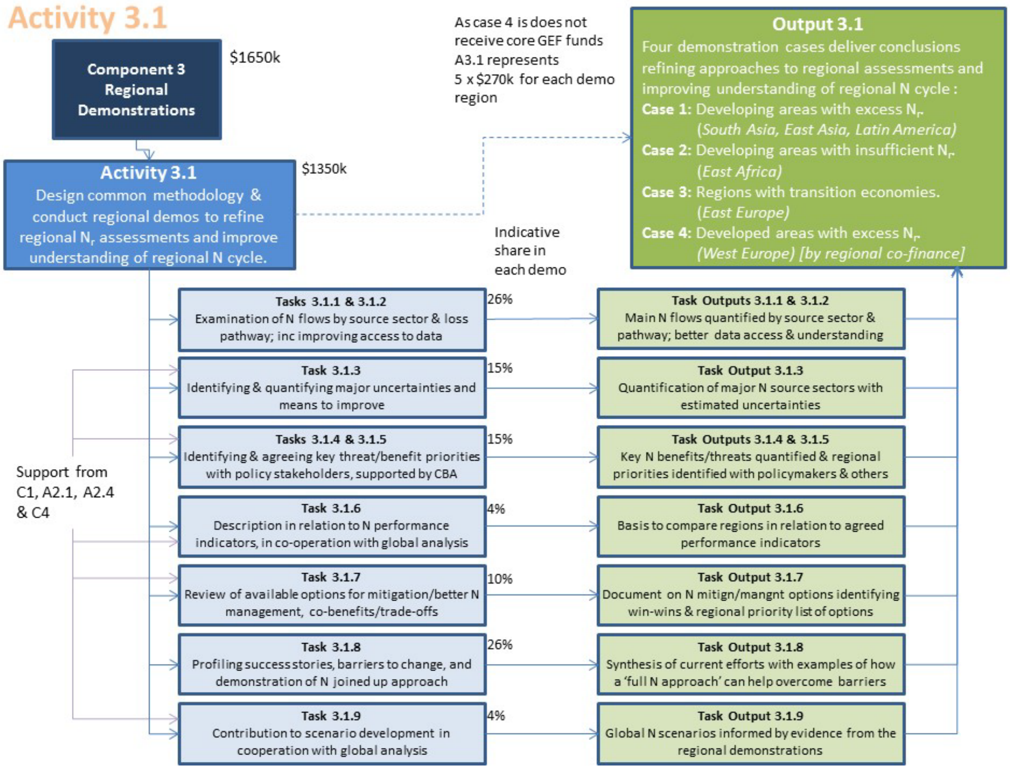


Figure A17e1: *Structure of Activity 3.1, including Tasks and Task Outputs.*

3.1.5 Linkages with GEF and non-GEF interventions

Ukraine is a participant of 42 International Conventions, Agreements and Protocols (Annex 4), links will be made where possible with the relevant departments which work on these agreements, for example at the Ministry of Ecology and Natural Recourses of Ukraine. The link must also be made to the Gothenburg Protocol of 1999 to Abate Acidification, Eutrophication and Ground-level Ozone to Convention on Long-range Transboundary Air Pollution, through the EPN-EECCA group (as mentioned earlier). Activities under the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol are also relevant, with respect to N_2O.

Characterization of the main N flows in the Lower Dniester region and the entire Black Sea is currently planned in frameworks of Ukrainian national projects. A first preliminary assessment of N budget for that region is also planned. Odessa National I. I. Mechnikov University (ONU) are engaged in these activities and would be able to contribute in part to the INMS work and discussions on sharing of their experiences and approaches. This institution would also be able to support the identification of major uncertainties in that particular demonstration region in frameworks of current Ukrainian national, EU and GEF projects related the Lower Dniester (EU FP7 ECLAIRE, Ukrainian national project) and the Black Sea region (GEF/UNDP EMBLAS II, EU FP7 PERSEUS, EU Black Sea Hot Spots, Ukrainian national project). This may also enable the review of available options for mitigation/better N management in for the region. National projects at ONU could also support the scenario development in cooperation with global analysis.

Ongoing work at partner NAAS (2016 – 2020) will be relevant for the work of INMS, for example:

- 'To develop a scientific basis to minimize emissions of nitrous oxide and ammonia from agricultural sources in accordance with the EU Common Agricultural Policy';
- 2. 'To develop scientific principles of rehabilitation of contaminated soils to improve security within the concept of Green Growth';

- 'To develop the scientific basis of environmental assessment agrobioresourses in the conditions of climate change';
- 'Ecological and Economic instruments of low carbon agricultural production in Ukraine'.

3.2 Project Sub-components and activities

As described earlier, the demonstration project for Eastern Europe sits under Activity 3.1 and includes 9 core tasks which are described briefly below (3.1.1-3.1.9) and shown in Figure A17e1. These tasks have then been sub-divided into 25 interim tasks (see Table A17e4). Detailed information on expected outputs including responsibilities of partner organizations are presented. The outcomes of Activity 3.1 will also feed in to inform developments in Component 2 in, A2.2 – global consolidated assessment & A2.3 - methods for better N management.

Table A17e4: *Detailed plan of work by interim task with proposed involving partners.*

Activity/Interim Task Number	Activity/Task name	Interim tasks	Outputs	Involved/responsible Partners
Activity 3.1	Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N cycle.		Regions with transitional economies (East Europe) demonstration case. Delivery of conclusions refining approaches to regional assessments and improving understanding of regional N Cycle	ONU, IAEM, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Interim task 1		Initial Meeting for planning and distribution of responsibility and terms between partners and consultants	Roadmap with responsibility of partners and consultants	ONU
Task 3.1.1 & Task 3.1.2	Examination of N flows by source sector & loss pathway; inc. improving access to data		Main N flows quantified by source sector & pathway; better data access & understanding	To be defined at initial workshop
Interim task 2		Development of regional N balance scheme and the information data base with regional data owners in all key sectors of inputs (emission) and outputs (removal, depositions	Initial literature review to determine important source sectors and pathways specific to EE region and to review and documents existing data sets, their	ONU, IAEM, EPN-ECCA, Moldavian partner * Romanian partner* Independent consultants*

Activity/Interim Task Number	Activity/Task name	Interim tasks	Outputs	Involved/responsible Partners
		etc) in region	availability and ease of access/use	
Interim task 3		Networking and Establishment database of stakeholders in EE region	Initial stakeholders analysis and network development, building on the ongoing literature review work above	IAEM, Moldavian partner * Romanian partner*
Interim task 4		Preparations of presentation with results of arrangement and implementation and EE region stakeholders Workshop in Ukraine	Stakeholder workshop to further define and agree upon important sector and pathways for the EE region. Workshop output will be formalized into a report for Submission to the Component 3 Management Group & Project Management Board, which also outlines how Task Outputs 3.1.3. will be achieved	IAEM, ONU, NE, EPN-ECCA Moldavian partner * Romanian partner*
Task 3.1.3	Identifying & quantifying major uncertainties and means to improve		Quantification of major N source sectors with estimated uncertainties	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner*
Interim task 5		Collection of existing and available data from Regional Communities in Ukraine, Moldova and Romania	Data gathering from Community on the agreed major N source sectors and pathways	IAEM, Moldavian partner * Romanian partner*
Interim task 6		Analysis of collected data and estimation/definition of EE regional N flows uncertainties	Part for Report on regional N flows for submission to Component 3 Management Group & Project Management Board	IAEM, ONU, EPN-ECCA, Moldavian partner * Romanian partner*
Interim task 7		Development of Recommendations for improvement of estimation/definition of EE regional N flows	Final Report on regional N flows for submission to Component 3 Management Group	IAEM, ONU, EPN-ECCA, Moldavian partner * Romanian partner*

Activity/Interim Task Number	Activity/Task name	Interim tasks	Outputs	Involved/responsible Partners
			& Project Management Board	
Task 3.1.4 & Task 3.1.5	Identifying & agreeing key threat/benefit and priorities with policy stakeholders, supported by CBA		Key N benefits/threats quantified & regional priorities identified with policymakers and other	IAEM, ONU, EPN-ECCA, Moldavian partner * Romanian partner*
Interim task 8		Collection and analysis of existing data for formulation of quantitative key N benefits/threats and regional priorities	Initial literature review on Key N benefits/threats in the EE region and CBA approaches	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner*
Interim task 9		Networking of stakeholders and scientists in EE region and involvement them in Demonstration activity	Formation of a stakeholders and scientists advisory group for the demonstration area	IAEM, ONU, NE Moldavian partner * Romanian partner* EPN-ECCA
Interim task 10		Arrange and carry out a Scientific/Research Conference with sectoral topics of benefits/threats of using N and for develop of CBA	Scientific Conference in Odessa	ONU, NE
Interim task 11		Arrange and carry out the Stakeholders Advisory Group (SAG) meeting for discussion of regional priorities	Working Meeting	IAEM, NE
Interim task 12		Analysis of collected data and findings of Conference and Workshop and quantification of threats and formulate the regional priorities	Synthesis report on quantified threats/and regional priorities for submission to the Component 3 Management Group & Project Management Board	ONU, IAEM, NE, EPN-ECCA, Moldavian partner * Romanian partner* Independent consultants*
Task 3.1.6	Description in relation to N performance indicators, in co-operation with global analysis		Basis to compare regions in relation to agreed performance indicators	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*

Activity/Interim Task Number	Activity/Task name	Interim tasks	Outputs	Involved/responsible Partners
Interim task 13		Participation in development of performance indicators	Engage with Component 3 Management Group to develop agreed performance indicators	IAEM, ONU, EPN-ECCA, Moldavian partner * Romanian partner* Independent consultants*
Interim task 14		Collection of information on agreed performance indicators	Gather information on agreed performance indicators	IAEM, Moldavian partner * Romanian partner*
Interim task 15		Develop of performance indicators list	Report on agreed performance indicators	IAEM, ONU, EPN-EECCA, Moldavian partner *, Romanian partner*
Task 3.1.7	Review of available options for mitigation/better N management, co-benefits/trade-offs		Document of N mitigation/management options identifying synergies & regional priority list of options	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Interim task 16		Collect and analyse information for mitigation /management practices in region	Conduct initial review of mitigation/management options for demonstration region in collaboration with A2.4	IAEM, EPN-EECCA, Moldavian partner * Romanian partner*
Interim task 17		Formulation of mitigation/management options and identifications of its regional priority options	Develop a consultation document on mitigation /management options, identifying potential win-wins & regional priority list of options	IAEM, ONU, EPN-ECCA, Moldavian partner * Romanian partner* Independent consultants*
Interim task 18		Analysis of collected information and preparation of document on mitigation/management options etc, for submission to the Component 3 Management Group (C3MG)& Project Management Board (PMB)	Synthesis the consultation information and develop document on mitigation/management options etc, for submission to the Component 3 Management Group & Project Management Board	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*)

Activity/Interim Task Number	Activity/Task name	Interim tasks	Outputs	Involved/responsible Partners
Task 3.1.8	Profiling success stories, barriers to change, and demonstration of N joined up approach		Synthesis of current efforts with examples of how "full N approach" can help overcome barriers	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Interim task 19		Analysis of current management practices and identify of the main barriers for introduction of "full N approaches" in EE region	Review and synthesis "full N approaches" in EE region	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Interim task 20		Preparation of presentation(s) for special Workshop to share current experience on "full N approaches" in a regional and global context.	Take an active part in a workshop with all Demonstration Management Boards and Activity 1.6 to share current experience on "full N approaches" in a regional and global context.	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Interim task 21		Preparation of presentation(s) for special Workshop to share INMS project experience on "full N approaches" in a regional and global context	Take an active part in a workshop with all Demonstration Management Boards and Activity 1.6 to share INMS project experience on "full N approaches" in a regional and global context	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Interim task 22		Preparation regional materials for Joint synthesis report on "full N approaches"	Contribute to synthesis report on "full N approaches" in collaboration with A1.6	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Task 3.1.9	Contribution to scenario development in cooperation with global analysis		Global N scenarios informed bt evidence from the regional demonstrations	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Interim task 23		To prepare of materials needed for modeling of regional scenarios in collaboration with A2.4	Review and document regional scenarios on collaboration with A2.4	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent

Activity/Interim Task Number	Activity/Task name	Interim tasks	Outputs	Involved/responsible Partners
				consultants*
Interim task 24		Organize a joint meeting with Stakeholder advisory board for discussion and final approval of regional priorities	Engage with the demonstration stakeholder advisory board to agree on priorities on a regional scale	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Interim task 25		To support of A2.4 on global scenarios modelling	Collaborative and support work of A2.4 on global scenarios (where feasible)	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Activity 3.2	Workshop to synthesize outcomes from demo. activities focusing on reducing adverse N impacts & maximizing co-benefits	Prepare presentation	Participation in the workshop	IAEM, ONU, NE, EPN-ECCA, Moldavian partner * Romanian partner* Independent consultants*
Activity 3.3	Building consensus on benchmarking N indicators for different regions and systems	To comment and to develop some recommendation for benchmarking N indicators for different regions and systems	Participation in discussion of list of benchmarking N indicators	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*
Activity 3.4	Refinement of regional approach to demonstrating benefits of joined up nitrogen management.	To prepare recommendation for regional approach for demonstration of joined up N management	Part of final report (document) for Component 3 Management Group & Project Management Board	IAEM, ONU, EPN-EECCA, Moldavian partner * Romanian partner* Independent consultants*

*(to be defined at start of project)

3.3 *Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; including improving access to data*

This task will involve conducting an inventory of reactive nitrogen flows of anthropogenic origin, which will require the development of a methodology for calculation and / or adaptation of existing international methodological approaches (IPCC and EMEP) taking into account ecological and economic conditions of a region. This inventory will look at aspects such as energy, industry, waste dumps and municipal waste and of course the agricultural pool (which includes manure harvesting and use, soil management and nitrous oxide emissions). The inventory will cover a number of nitrogen species and methods of transport – flows in both water and air. Links will be made to existing data sources and approaches, such as IPCC and the State Statistical Office of Ukraine. Improvements in the reliability of the inventory and the level of uncertainty will be obtained by working with experts in the field of inventory by sector of economic activity (e.g. energy, agriculture and waste).

3.3.1 Task 3.1.3: Identifying & quantifying major uncertainties and means to improve

The uncertainties (e.g., related to data gaps, local condition peculiarities etc.) obviously emerging under the nitrogen flow inventory will be discussed and additionally re-considered in order to find the way of inventory improving.
In the case of farm animal emissions, manure management systems and cultivation of agricultural soils we are already aware of categories which potentially lead to uncertainties in the inventory results:

- livestock numbers;
- volumes of manure per number and type of farm animals;
- amount of volatile solids and nitrogen in manure;
- distribution of manure between manure treatment systems;
- volumes of applied mineral nitrogen fertilizers;
- volumes of applied organic nitrogen fertilizers;
- volumes of manure that remains on pastures;
- area of cultivated organic soils;
- performance levels of crop yields, cultivated in the region of study;
- area of crops harvested;
- area of nitrogen fertilizers and manure-use;
- coefficients of mineralization of organic residues;
- deposition of nitrogen from the atmosphere in the form of NH3 and NOx;
- leaching / runoff of nitrogen;
- nitrous oxide emission factors.

It will be necessary to look at these during the project to assess their contribution to the overall uncertainty in the inventory and to determine whether further investigation will be needed.

3.3.2 Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA

This Task is aimed at finding opportunities for implementation of an action plan to reduce the volume of reactive nitrogen flow of human origin and establishing the main barriers and benefits both for the environment and socio-economic development of the studied region. Also this will support the process of development and implementation of polices and measures (development of an action plan) for climate change mitigation & adaptation at regional and local levels. A list of potential suggestions to improve the implementation of activities will be submitted to persons responsible for decision-making at the regional level, public organizations and interested parties. Further research will be done on finding ways to overcome the existing barriers

3.3.3 Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis

In this Task the developing work on N sources, flows and impacts from Component 1 on the development of nitrogen system indicators (Activity 1.1.1), will be linked to the data being collected in the demonstration region. This will allow the information to be processed in a way that is consistent with developing international standards through the project, allowing full comparability of results from this region, with the others. Some of this work will take place as part of the Annual Meetings of the project, to promote sharing and effective communication.

3.3.4 Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs

The results of the inventory calculations of reactive nitrogen flows of human origin will be considered, along with a review of available options in the region for better nitrogen management. Relevant co-benefits or trade-offs associated with different management technologies and management options will be considered, including taking experiences from existing international guidance methods, to reduce nitrogen pollution. Including (but not exclusively), the UNECE Guidance Document on Mitigation on Agricultural Nitrogen, EC IPCC BAT Reference documents and those relating to the Water framework Directive.

3.3.5 Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach

A series of regional and national case studies are planned, which showcase existing successful nitrogen mitigation activities, which were discovered during the earlier analysis of national experience and best international practices. Using these experiences and the review, a synthesis for each region on current efforts will be developed. This will include examples of how the full nitrogen approach can help overcome barriers by delivering simultaneous increase of resource use efficiency (direct financial benefit) and reduction of environmental pollution (social benefit through improved health and environment).

3.3.6 Task 3.1.9: Contribution to scenario development in cooperation with global analysis

Developing a regional scenario is a crucial challenge often requiring co-financing to obtain and analysed additional data demanded. Therefore, while this option is explored, the basic task will be to review the validity and relevancy of suggested simulations developed on collaboration with Activity 2.4. A short document will be prepared which reviews the applicability of the proposed scenarios to this region and suggests specific issues etc. that are relevant in the EE region.

3.4 Budget and co-financing

3.4.1 Budget

Table A17e5: *Budget breakdown by cost type.*

Cost Type	Cost per year (USD)	Cost for project [4 years] (USD)	Notes
Establishing and supporting a regional team			
Regional Co-ordinator	8600	34400	Depend on commitments
Project Officer 1 (post-doc level)	8200	32800	
Project Officer 2 (post-doc level)	8200	32800	
Office and admin costs (including printing budget for dissemination materials)	2000	8000	Depends on condition
Total	***27,000***	***108,000***	
Support for meetings (including travel and venue budgets, preparing communications, reports and experiences)			
Travel & Subsistence Costs	10000	40000	
Venue and Catering Costs	17000	68000	
Preparing reports etc.	6750	27000	
Total	***33,750***	***135,000***	
Additional bought in Services (e.g. to supplement key datasets, additional necessary information etc)			
Total	***6,750***	***27,000***	
Total for Demonstration	**67,500**	**270,000**	

Table A17e6: *Budget breakdown by Task*

Task	Cost (USD)	Notes
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	70,200	**Workshops, meetings, travels**
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	40,500	
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	40,500	
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	10,800	
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	27,000	
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	70,200	**Workshops, meetings, travels**
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	10,800	
Total	**270,000**	

3.4.2 Co-financing

Table A17e7a: *Summarized financing budget by Task and Partners (according to the Letters of Commitment; real share of partners and notes indicated below in Table A17e7b)*

Task	Total Co-financing (USD)	Partner(s)
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	236,200	UNECE, ONU, IEEP, IAEM, VNIIOU
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	85,500	ONU, IEEP, IAEM, VNIIOU
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	66,500	IEEP, IAEM, VNIIOU, NGO 'New Energy'
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	19,800	IEEP, IAEM, VNIIOU, ONU
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	67,000	ONU, IEEP, IAEM, VNIIOU
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	116,2	IEEP, IAEM, VNIIOU
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	34,800	ONU, IEEP, IAEM, VNIIOU
Total	**626,000**	

Table A17e7b: *Co-financing budget, listed by Task and Partner (according to the Letters of Commitment with full notes) [Note that as per the list of partners stated in Section 3.1.3, Scientific Research Institute for Atmospheric Air Protection (SRI), Russia; & Commission on the Protection of the Black Sea Against Pollution (BSC PS), Turkey; will also be involved, but their co-financing of Activity 3.1 will be determined during project implementation]*

Task	Co-financing (USD)	Partner	Notes (including information on the project, links to the tasks, project duration etc.)
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	50,000	UNECE	Provision of baseline information on the Dniester and Danube river basins based on previous and ongoing projects on transboundary water cooperation between the Republic of Moldova and Ukraine. Provision of data on air pollutant emissions based on national inventories submitted under the CLRTAP Convention.
	30,000	ONU	We are currently working on characterization of the main N flows in the Low Dniester region and the entire Black Sea in frameworks of National projects. A first preliminary assessment of N budget for those regions is also planned. Staff on this project would be able to contribute in part to the work and discussions on sharing of experiences.
	26,000	IEEP	The Work Plan of our Institute (IEEP) for the years 2015-2018 includes calculation of nitrogen budgets in the agricultural sector at region, municipality and farm level in order to analyze the nitrogen flows. This topic is included in the current international project ERAB-SI.
	70,200	IAEM	We are currently developing the investigation on the influence of reactive nitrogen on ecosystems in our country Main N flows will be determined by source sector and loss pathway. Demonstration and verification of management tools at the local level will be undertaken to verify the approaches and tools agreed for understanding and managing the impacts of reactive N.
	60,000	VNIIOU	The Work Plan of our Institute (VNIIOU) for the years 2015-2018 includes Research and Development with estimation of N balance and cycle for different organic and mineral fertilization schemes in long-term field experiments (LTE) and development of measures which decrease atmospheric loss and leaching in groundwater of mineral N applied with organic fertilizers and prevent losses under storage of organic fertilizers.
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	20,000	ONU	In the frameworks of the Low Dniester and the Black Sea research projects, we would be able to propose our partial contributions via both in-kind and in-cash, at least for identification of major uncertainties in that region.
	15,000	IEEP	In the framework of IEEP activities, we plan to test the methodology for nutrient flows analysis through the example of agricultural enterprises of different type and size, mainly large-scale ones.
	40,500	IAEM	We have experience in the organization of processes for preparing of GHG Inventory Reports (2004-2012). Also, we participated in the calculation of levels of uncertainty of all sectors of GHG emissions. So we will be able to organize the process of preparing the calculation of the uncertainty of the project results and the finding of decisions for improvement of the results.

	10,000	VNIIOU	We plan to test the methodology for nutrient flows analysis through the example of agricultural enterprises of different type and size in Central Russia
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	15,000	IEEP	We plan to use of the outcomes of current and completed international HELCOM projects BaltHazAr and BASE.
	40,500	IAEM	We have experience in communication and interaction with policymakers at the national and the regional levels. Based on the legislation and national programs of sectoral development of Economy we will be able to identify key threats and benefits and assign priorities.
	10,000	VNIIOU	We plan to use the research results obtained in the survey of agricultural enterprises in the years 1995-2016.
	1,000	NGO 'New Energy'	The organization of workshops will help the effort.
Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	4,000	IEEP	We will employ the outcomes of current and completed projects.
	10,800	IAEM	We participated in the research project for preparing the roster of policies and measures for low-carbon development of Ukraine, with cost/benefits analysis. We can use this experience for finding the most optimal options for N management and for the development and harmonization of different N indicators representing environmental, production and efficiency aspects.
	5,000	VNIIOU	We will use the results of the estimation of N balance in farming in Russia.
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	15,000	ONU	The staff of the abovementioned National project would be able to contribute in part to that review in terms of the investigated region.
	10,000	IEEP	The topic is in line with our general research programme for the years 2015-2018. We plan to use the outcomes of the joint project with UBA (Germany) concerning BAT introduction.
	27,000	IAEM	There will be the development of a document for available options for mitigation/better N management, co-benefits/trade-offs.
	15,000	VNIIOU	The topic is in line with our general research programme for the years 2015-2018.
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	26,000	IEEP	The topic is in line with our general research programme for the years 2015-2018.
	70,200	IAEM	Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers in the demonstration-region of East Europe.
	20,000	VNIIOU	Demonstrate effective use of nitrogen on farms in Central Russia the years 2016-2018.
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	5,000	ONU	Based on our National projects achievements, we would also be willing to contribute in part to scenario development.
	4,000	IEEP	We plan to present Guidelines and Methods developed at IEEP.
	10,800	IAEM	On the basis of research at the level of regional demonstration (Eastern Europe), proposals for the creation of a global scenario of nitrogen management will be developed.
	15,000	VNIIOU	Demonstrate effective use of nitrogen on farms in Central Russia for the years 2016-2018.
Total	**626,000**		

3.5 Work Plan

Work Plan for Activity 3.1, Eastern Europe demonstration: **M** = Meeting, **R**= Report (includes other publications), **W** = Workshop

Activity 3.1 Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Tasks 3.1.1 & 3.1.2 Examination of N flows by source sector & loss pathway; inc improving access to data		M				M			W							
Task 3.1.3 Identifying & quantifying major uncertainties and means to improve																
Tasks 3.1.4 & 3.1.5 Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA		M							W							
Task 3.1.6 Description in relation to N performance indicators, in co-operation with global analysis									W			R				
Task 3.1.7 Review of available options for mitigation/better N management, co-benefits/trade-offs		M							W			R				
Task 3.1.8 Profiling success stories, barriers to change, and demonstration of N joined up approach									W			R				
Task 3.1.9 Contribution to scenario development in cooperation with global analysis		M				M						R				
Monitoring and Evaluation					R				R			R	R			R

3.6 Sustainability

This demonstration is one of five funded demonstration activities, which will adopt and refine a common methodology aimed at providing a template for other regions to plan future activities for the assessment and management of their nitrogen problems. The aim is to elaborate a comparable methodology, which would also be adaptable to regional needs and capabilities. This methodology should also allow the development of activities which could be maintained and updated to ensure sustainability.

3.7 Replication

As noted in the above section, it is the intention that the methodology adopted will allow the future replication of activities in other regional settings. In the context of this demonstration replication to the wider Eastern Europe area. E.g., to the East along the Black Sea covering the South Bug, the Severskiy Donets, the Dnieper, the Mzymta, the Schakhe, the Psou Basins etc, would seem a logical next step.

3.8 Awareness raising, communications and dissemination

The success of this project implementation depends on the degree of awareness and understanding of the objectives by decision-makers at the national and regional levels. It is necessary to inform stakeholders as well as decision-makes dessiminating the information regarding project objectives and progress. This can be achieved by:

- Publication of open letters to Ministry/local administration, newsletters for public and / or brochures;
- Organizing of interviews and/ or making small video reports on national/local TV
- Holding workshops to initiate dialogue with decision-makers and all stakeholders;
- Attraction of national experts of the scientific research profile to increase confidence in the information on the results of conducted calculations of the human origin reactive nitrogen flows inventory , as well as forward-looking assessments

3.9 Execution arrangements

A 'Demonstration Management Group' (DMG) will oversee the work of the regional demonstration activity, in collaboration with a Stakeholder Advisory Group (SAG) (see Figure A17f1). The DMG will be responsible for reporting to the Component 3 Management Group on its progress and the use of finances. A more detailed diagram of the interactions and development of data etc, can be found in Annex 5.

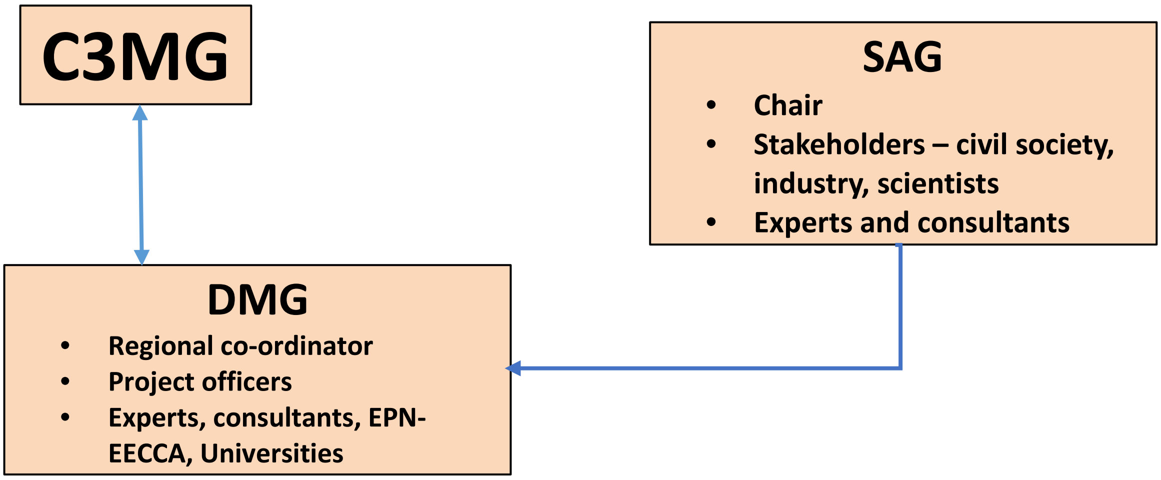


Figure A17f1: *Organigram of groups in East Europe Demonstration*

4 Monitoring and Evaluation

4.1 Monitoring of progress and project evaluation

Outcome and output indicators are specified to support monitoring of the project progress (see Table A17e8). Monitoring will be based on the results of each task and interim task and will draw on the lessons learnt. A Work Plan will be developed by the Regional Co-ordinator for agreement by the Demonstration Management Group and the Component 3 Management Group and reviewed annually. Further details on frequency of reporting between the Demonstration Management Group and the Component 3 Management Group can be proposed and agreed at the start of the project.

The Demonstration Management Group, in collaboration with the Component 3 Management will ensure that all necessary information is provided in a timely manner to the Project Co-ordination Unit and Project Management Board, to allow the delivery of the following reports:

- Inception report
- Annual Reports to UNEP
- Final report including lessons learned and exit strategy

They will also comply with any requests in relation to the mid-term and final evaluation procedures as set out by GEF. Demonstration Project Results Framework
A detailed log-frame (project results framework) is shown below (Table A17e8), which covers aspects that are specific to the East Europe Regional Demonstration. It should be read in conjunction with the project results framework for Component 3 as a whole (see Appendix 17), which emphasizes common aspects between the different INMS demonstration regions.

Table A17e8: *East Europe results framework*

	Objectively Verifiable Indicators			Sources of Verification	Assumptions
Outcomes, Outputs and Activities	Indicator	Baseline	Target		
Outcome 4: GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised	Project-level demonstration methodology guidelines adopted and published Requests for and application of demonstration area methodologies, tools and practice by external parties	Limited information from previous GEF interventions and partial N budget recently developed.	Project level methodology developed and agreed. Uptake of demonstration area methodology in other areas.	Workshop reports Contribution to synthesis documents	Active participation of the populations and policy makers in East Europe Availability of diversified expertise and technologies in East Europe
Output 3.1: A demonstration activity which delivers conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing: Case 2: Challenges and opportunities for developing areas with insufficient reactive nitrogen. (Note that some aspects are also relevant to Case 1: Challenges and opportunities for developing areas with excess reactive nitrogen)	Report on N sources and N flows for East Europe. Report on consensus on N priority sources, forms and impacts for East Europe. Regional condition according to agreed N performance indicators. Information on priority N management and mitigation options. Information on	Lack of joined up data on N sources and flows regionally. Lack of knowledge on how N sources and impacts fit together. Lack of knowledge on how different N indicators relate, especially at regional level. Diversity of views and lack of consensus on the best methods to obtain N co-benefits.	Quantified N flows, with uncertainty indication by end Year 3. Clearly identified priorities for N sources, forms and impacts by end Year 3 Statement of East Europe performance in using agreed N indicators by end Year 3. Draft 'Top 10' priority measures for improved N management for East Europe (end Year 2).	Reports, contrib'n to global synthesis (A2.2). Reports of science-stakeholder workshops. Report and contribution to INMS publications. Report provided to A2.3 for incorporation in global comparison.	

	successes and opportunities. Information on regional specificities for global scenarios	 Variable progress, with limited attention to linking N co-benefits Existing global scenarios paying insufficient attention to regional conditions.	Document for East Europe, showing how N approach can address barriers and share success stories (Year 4). Global scenarios informed by evidence from the East European Demonstration (Year 3).	 Documents for East European demonstration. Report from A2.4 workshop.	

Annex 1: Projects and Conventions related to the current work in the demonstration region

Table 1: *The list of the projects with potential links to the current work in demonstration region*

Number	**Project**	**Funding**
1	International management of risk in The Dniester River Basin	Federal Office for the Environment of Germany
2	Promoting European Union Water Directive for Integrated Water Resources Management	Regional Ecological Centre of Moldova
3	Save our Rivers	Regional Ecological Centre of Moldova
4	Management of Water Resources in Western Countries of EECCA	EU-TACIS
5	Ecological Collaboration in the Black Sea Basin	EU-TACIS
6	National Dialogue on Water Policy in the integrated management water Resources	ENECE
7	Conservation of aquatic biodiversity in the Lower Dniester	ECO-TIRAS/Black Sea Regional Cooperation Foundation, USA
8	The Democratization of Management in the Dniester River Basin	SPA of Moldova and Ukraine/MATRA Programme, Netherlands
9	Capacity-building in the Field of Data Management for the Assessment of Transboundary Water Resources in the EECCA countries	IWAC, France
10	Creating a Plan for the Reconstruction of the Reserve Yagorlyk	UNDP, Moldova
11	Integrated Framework for flood protection on the rivers Prut, Siret and Dniester	National programme, Ukraine
12	Raising Awareness of Stakeholders on Climate Change and its Impact on the Region of the Lower Dniester	ECO-TIRAS/Rosa Luxemburg Foundation, Germany/The Black Sea Development Foundation, USA
13	Water Quality Management and Conservation of Biodiversity in the Lower Dniester	GEF/UNDP, Moldova

Number	Project	Funding
14	Biodiversity Conservation in the Lower Dniester Delta Ecosystem	GEF/UNDP, Moldova
15	Dniester GIS - Information Management System and Infrastructures for the TransboundaryDniesterRiver Basin.	UNEP/GRID Arendal
16	Transboundary Co-operation and Sustainable Management of the DniesterRiver (Dniester I)	OSCE/UNECE
17	Action Programme: to Improve Transboundary Co-operation and Sustainable Management of the DniesterRiver Basin (Dniester II)	OSCE/UNECE
18	Transboundary cooperation and sustainable management in the DniesterRiver basin: PHASE III – Implementation of the Action Programme (Dniester III)	OSCE/UNECE
19	Improving cross-border cooperation in the field of integrated water resources management in the Euroregion "Lower Danube"	EU
20	Preventing emergencies and flood protection in the Euroregion" Lower Danube	EU
21	Business infrastructure Odessa region, Euroregion "Lower Danube "	EU-TACIS
22	Lower Danube Lakes: Sustainable Restoration and Protection of Habitats and Ecosystems	EU-TACIS

Number	Project	Funding
23	Danube Lakes, Ukraine. Sustainable restoration and conservation of natural ecosystems	EU-TACIS
24	Development of New Methods to Process Information about the Quality of Water in River Basins	INTAS
25	Technical Assistance for the Lower Dniester Basin Management Planning	EU-TACIS
26	Environmental Protection of International River Basins Project (EPIRB)	UNDP/GEF
27	Capacity building in data administration for assessing transboundary water resources in the countries of Eastern Europe, Caucasus and Central Asia (EECCA)” (countries: MD and UA)	EU
28	Development of a Danube Delta Analysis including a Joint Danube Delta Survey (countries: UA, MD and RO)	UNECE/ENVSEC
29	Technical and economic justification of the international flood-control system in the Tisza basin	EU-TACIS
30	Flood-prevention management in Slovakia and Ukraine	Danish Cooperation for Environment in Eastern Europe (DANCEE)
31	Assessment and management of flood risks in Zakarpatskaya region	EU-TACIS

Number	Project	Funding
32	Prevention and flood protection in Siret and Prut river basins, through the implementation of a modern monitoring system with automatic stations	EAST AVERT
33	Sustainable Integrated Management of International River Corridors in SEE Countries (SEE River)	South-Eastern Europe Transnational Cooperation (SEETC) Programme

Table 2a: *Activity of GEF in the Eastern Europe Demonstration Region with the participation of Ukraine (source: https://www.thegef.org/gef/sites/thegef.org/files/publication/Ukraine.pdf)*

GEF_ID	Country	Project Name	Focal Area	Agency	Project Type	GEF Grant	Co-financing	Status
Approved National Projects								
100	Ukraine	Danube Delta Biodiversity	Biodiversity	World Bank	FP	1,500,000	240,000	Project Closure
Approved Regional and Global Projects								
341	Regional	Developing the Implementation of the Black Sea Strategic Action Plan	International Waters	UNDP	FP	1,790,000	6,955,000	Project Closure
342	Regional	Developing the Danube River Basin Pollution Reduction Programme	International Waters	UNDP	FP	3,900,000	3,600,000	Project Closure
397	Regional	Black Sea Environmental Management	International Waters	UNDP	FP	9,300,000	23,300,000	Project Closure
399	Regional	Danube River Basin Environmental Management	International Waters	UNDP	FP	8,500,000	35,000,000	Project Closure
405	Regional	Black Sea Environmental Management	International Waters	UNDP	FP	693,750	37,500	Project Closure
1014	Regional	Danube/Black Sea Basin Strategic Partnership on Nutrient Reduction, Tranche I	International Waters	World Bank	FP	0	0	Council Approved
1460	Regional	Strengthening the Implementation Capacities for Nutrient Reduction and Transboundary Cooperation in the Danube River Basin-Phase I, Project Short Title: Danube Regional Project Phase 1	International Waters	UNDP	FP	5,000,000	6,600,000	Under Implementation

GEF_ID	Country	Project Name	Focal Area	Agency	Project Type	GEF Grant	Co-financing	Status
1580	Regional	Control of Eutrophication, Hazardous Substances and Related Measures for Rehabilitating the BLACK SEA Ecosystem: Phase 1	International Waters	UNDP	FP	4,000,000	3,945,000	Under Implementation
1661	Regional	Danube/Black Sea Strategic Partnership - Nutrient Reduction Investment Fund: Tranche 2	International Waters	World Bank	FP	0	0	Council Approved
2042	Regional	Strengthening the Implementation Capacities for Nutrient Reduction and Transboundary Cooperation in the Danube River Basin: Tranche 2	International Waters	UNDP	FP	12,000,000	12,878,000	Project Completion
2044	Regional	Strategic Partnership for Nutrient Reduction in the Danube River and Black Sea - World Bank-GEF Nutrient Reduction Investment Fund: Tranche 3	International Waters	World Bank	FP	0	0	Council Approved
2263	Regional	Control of Eutrophication, Hazardous Substances and Related Measures for Rehabilitating the Black Sea Ecosystem: Tranche 2	International Waters	UNDP	FP	6,000,000	5,332,106	Project Completion
3871	Global	4th Operational Phase of the GEF Small Grants Programme (RAF2)	Multi Focal Area	UNDP	FP	42,714,904	43,000,000	CEO Endorsed
4102	Regional	Initial Implementation of Accelerated HCFC Phase-out in the CEIT Region	Ozone Depleting Substances	UNDP	FP	9,000,000	12,300,000	CEO Endorsed
Cancelled Projects								
412	Ukraine	Biodiversity Conservation in the Azov-Black Sea Ecological Corridor	Biodiversity	World Bank	FP	6,900,000	26,140,000	Cancelled

Table 2b: Activity of GEF in the Eastern Europe Demonstration Region, with the participation of Moldova

GEF_ID	Country	Project Name	Focal Area	Agency	Project Type	GEF Grant	Co-financing	Status
Approved National Projects								
1355	Moldova	DBSB Agricultural Pollution Control Project - under WB-GEF Strategic Partnership for Nutrient Reduction in the Danube River and Black Sea	International Waters	World Bank	FP	4,950,000	5,690,000	Project Completion
1600	Moldova	Biodiversity Conservation in the Lower Dniester Delta Ecosystem	Biodiversity	World Bank	MSP	975,000	1,040,550	Project Closure
Approved Regional and Global Projects								
342	Regional	Developing the Danube River Basin Pollution Reduction Programme	International Waters	UNDP	FP	3,900,000	3,600,000	Project Closure
399	Regional	Danube River Basin Environmental Management	International Waters	UNDP	FP	8,500,000	35,000,000	Project Closure
1014	Regional	Danube/Black Sea Basin Strategic Partnership on Nutrient Reduction, Tranche I	International Waters	World Bank	FP	0	0	Council Approved
1460	Regional	Strengthening the Implementation Capacities for Nutrient Reduction and Transboundary Cooperation in the Danube River Basin-Phase I Project Short Title: Danube Regional Project Phase 1	International Waters	UNDP	FP	5,000,000	6,600,000	Under Implementatio n
1661	Regional	Danube/Black Sea Strategic Partnership - Nutrient Reduction Investment Fund: Tranche 2	International Waters	World Bank	FP	0	0	Council Approved

GEF_ID	Country	Project Name	Focal Area	Agency	Project Type	GEF Grant	Co-financing	Status
2042	Regional	Strengthening the Implementation Capacities for Nutrient Reduction and Transboundary Cooperation in the Danube River Basin (Tranche 2)	International Waters	UNDP	FP	12,000,000	12,878,000	Project Completion
2044	Regional	Strategic Partnership for Nutrient Reduction in the Danube River and Black Sea - World Bank-GEF Nutrient Reduction Investment Fund: Tranche 3	International Waters	World Bank	FP	0	0	Council Approved
Cancelled Projects								
1542	Moldova	DBSB Environmental Infrastructure Project - under Strategic Partnership Investment Fund for Nutrient Reduction in the Danube River Basin and the Black Sea	International Waters	World Bank	FP	4,562,000	5,338,000	Cancelled

Table 2c: *Activity of GEF in the EAST EUROPE Demonstration Region with the participation of Romania*

GEF_ID	Country	Project Name	Focal Area	Agency	Project Type	GEF Grant	Co-financing	Status
Approved National Projects								
69	Romania	Danube Delta Biodiversity	Biodiversity	World Bank	FP	4,500,000	300,000	Project Closure
1159	Romania	DBSB: Agricultural Pollution Control Project - under WB-GEF Strategic Partnership for Nutrient Reduction in the Danube River and Black Sea	International Waters	World Bank	FP	5,150,000	5,650,000	Project Closure

GEF_ID	Country	Project Name	Focal Area	Agency	Project Type	GEF Grant	Co-financing	Status
2970	Romania	DBSB: Integrated Nutrient Pollution Control Project-under the WB-GEF Investment Fund for Nutrient Reduction in the Danube River and Black Sea	International Waters	World Bank	FP	5,500,000	75,700,000	Under Implementation
Approved Regional and Global Projects								
341	Regional	Developing the Implementation of the Black Sea Strategic Action Plan	International Waters	UNDP	FP	1,790,000	6,955,000	Project Closure
342	Regional	Developing the Danube River Basin Pollution Reduction Programme	International Waters	UNDP	FP	3,900,000	3,600,000	Project Closure
397	Regional	Black Sea Environmental Management	International Waters	UNDP	FP	9,300,000	23,300,000	Project Closure
399	Regional	Danube River Basin Environmental Management	International Waters	UNDP	FP	8,500,000	35,000,000	Project Closure
405	Regional	Black Sea Environmental Management	International Waters	UNDP	FP	693,750	37,500	Project Closure
867	Regional	Transfer of Environmentally-sound Technology (TEST) to Reduce Transboundary Pollution in the Danube River Basin	International Waters	UNDP	MSP	990,000	1,410,000	Project Closure
1014	Regional	Danube/Black Sea Basin Strategic Partnership on Nutrient Reduction: Tranche I	International Waters	World Bank	FP	0	0	Council Approved
1460	Regional	Strengthening the Implementation Capacities for Nutrient Reduction and Transboundary Cooperation in the Danube River Basin-Phase I, Project Short Title: Danube Regional Project Phase 1	International Waters	UNDP	FP	5,000,000	6,600,000	Under Implementation
1580	Regional	Control of Eutrophication, Hazardous Substances and Related Measures for Rehabilitating the BLACK SEA Ecosystem: Phase 1	International Waters	UNDP	FP	4,000,000	3,945,000	Under Implementation

GEF_ID	Country	Project Name	Focal Area	Agency	Project Type	GEF Grant	Co-financing	Status
1661	Regional	Danube/Black Sea Strategic Partnership - Nutrient Reduction Investment Fund: Tranche 2	International Waters	World Bank	FP	0	0	Council Approved
2042	Regional	Strengthening the Implementation Capacities for Nutrient Reduction and Transboundary Cooperation in the Danube River Basin (Tranche 2)	International Waters	UNDP	FP	12,000,000	12,878,000	Project Completion
2044	Regional	Strategic Partnership for Nutrient Reduction in the Danube River and Black Sea - World Bank-GEF Nutrient Reduction Investment Fund: Tranche 3	International Waters	World Bank	FP	0	0	Council Approved
2263	Regional	Control of Eutrophication, Hazardous Substances and Related Measures for Rehabilitating the Black Sea Ecosystem: Tranche 2	International Waters	UNDP	FP	6,000,000	5,332,106	Project Completion
2806	Regional	Promoting Payments for Environmental Services (PES) and Related Sustainable Financing Schemes in the Danube Basin	Biodiversity	UNEP	MSP	964,676	1,374,373	Project Completion
Cancelled Project								
1615	Regional	Geothermal Energy Development Program, GeoFund	Climate Change	World Bank	FP	9,384,422	163,520,000	Cancelled

Annex 2: Terms of Reference for Partners / Key Consultants

Terms of Reference for the roles of Demonstration Project Co-ordinators and Project Officers along with potential consultants, is included in Appendix 11. The remit of these roles, along with decisions on the institutions and persons taking on these roles for each Demonstration Region, will be subject to endorsement by the Project Partners Assembly at the Inception meeting of the project.

Annex 3: Details about Demonstration Region

Eastern Europe demonstration region area is presented in Figure 1.

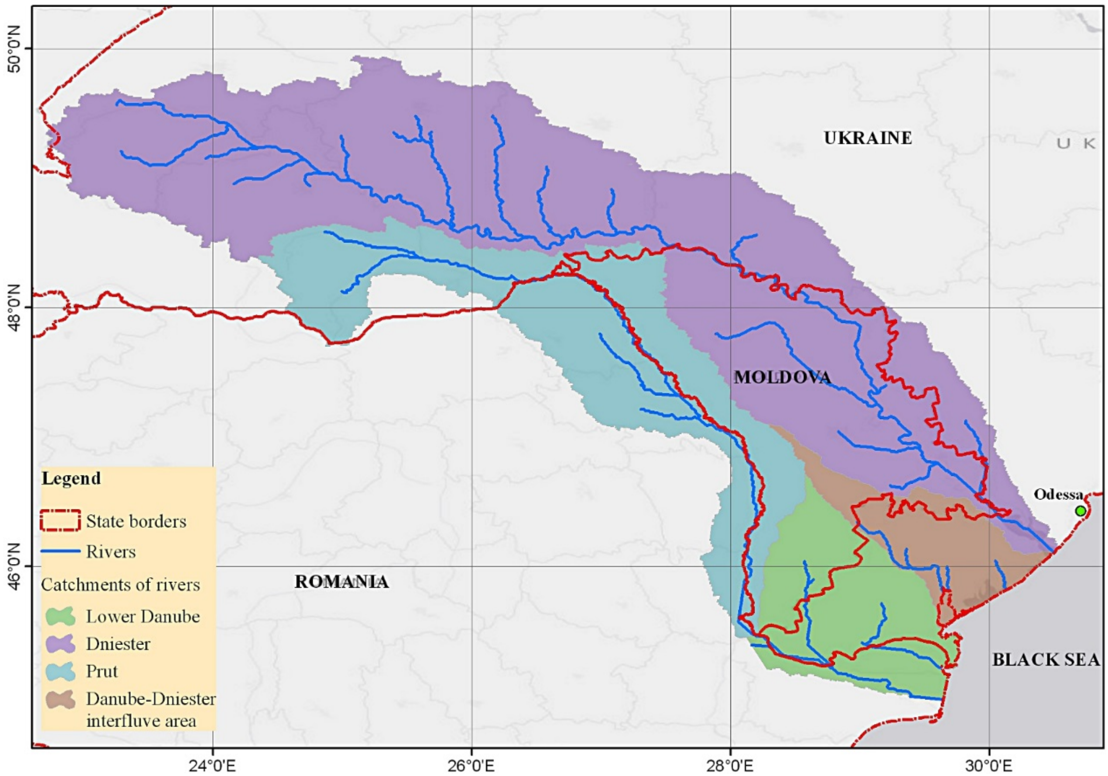


Fig. 1. Map of Eastern Europe Demonstration Region

Brief characteristics of sub-regions in the demonstration area are described below.

The Dniester Basin

The basin of the 1,362-km long river Dniester is mainly shared by Ukraine and the Republic of Moldova, with a small proportion in Poland (Table 3). The river has its source in the Ukrainian Carpathians, and discharges into the Black Sea. Major transboundary tributaries include the Kuchurhan and the Yahorlyk. The basin is mountainous in the upper part, and lowlands prevail in the lower part. Valuable wetland systems extend along the Dniester Estuary, including some 100 wetland lakes (10-15 of the lakes are considered major). They play a vital role in maintaining the water balance and supporting the basin's biological diversity.

Table 3: *Basin of the Dniester River (Source: Statistical Yearbook Environment of Ukraine, Kyiv 2008; Ministry of Environment, the Republic of Moldova.)*

Country	Area in the country (km^2)	Country's share (%)
Ukraine	52 700	72.9
Republic of Moldova	19 400	26.6
Poland	226	0.3
Total	72 326	

Surface water resources in the Ukrainian part of the Dniester basin are estimated at 10.7 km^3 $year^{-1}$ in an average year (at 6 km^3 $year^{-1}$ in a dry year) and groundwater resources at 1.87 km^3 $year^{-1}$. More than 90% of the total flow of the Dniester is generated in Ukraine. The majority of the aquifers are only weakly connected to surface waters. In the Moldovan part, surface water resources are estimated at 9.87 km^3 $year^{-1}$ (average for 1954 to 2008). The Dniester has a highly specific flood regime, featuring up to five flood events annually, during which water levels may increase by 3–4 m or even more. The significant variability of water levels, especially in the upper Carpathian reach, is attributed to the river channel's low capacity. No significant changes in surface water quality have been registered in Ukraine during the period from 2007 to 2009. At Mogilev-Podolsky and Jampol utilities, in 2008–2009 exceedance in the concentrations of organic matter and ammonium nitrogen were observed. The main pollutants are nitrogen, organic matter, phosphates, suspended solids and synthetic surfactants. At some monitoring points, copper is also a quality defect that occurs. In the Carpathian part of the Dniester, concentrations of metals systematically exceed MACs (e.g. iron and manganese).

Despite improvement of water quality over the last decade, related to a decrease in economic activity, significant water quality problems remain. Trends of salinization and eutrophication of the Dniester estuary are observed.

The Prut Basin

The Prut River, originates on the South-Western slope of the Hoverla mountain (ca. 15 km South–Southeast of Vorokhta village) and flows into the Danube south of Giurgiulesti village (ca. 164 km from the Danube mouth). The length of the river is ca. 967 km, water basin area is 27 540 km^2 and elevation drop is 1577 m. The Prut River Basin is transboundary and covers 27 500 km^2, located in the territory of Romania (39% of the entire basin), Ukraine (33%) and Moldova (28%). The Romanian part of the Prut Basin is the biggest one. It forms the border between Romania and Moldova over 695 km. The Ukrainian part of Prut River basin is located in Ivano-Frankovsk and Chernovtsy regions (oblasts). The upper part of the river basin is located within the Ukrainian Carpathians and the lower – within the Subcarpathian uplands of the East European Platform. The Moldovian part of the Prut River Basin is narrower, about 340 km long with average width of 51 km only. Due to its geological structure, geomorphological features and climate conditions, physical-geographical characteristics are significantly varied.

The Danube Delta

The Delta of the Danube starts beyond the mouths tributaries from the Siret and Prut. Its area is one of the largest natural river deltas in Europe. It is one of the world's most important ecoregions for biodiversity, included in the WWF Global 200 list[1]. The Danube Delta includes a number of small rivers, estuarian-origin lakes and estuaries, shared between the Republic of Moldova, Romania, and Ukraine (total square >1 million ha). The Danube forms a wetland delta with length from the East to the West of around 75 km, and a with width of 65 km. The Danube splits into 2 mouths Chilia and Tulcea.

The Danube-Dniester interfluve area

This area includes four major 'lakes' (the Sasyk, the Shahany, the Alibei and the Buras), which have estuarian origin, and a number of small rivers are connected with them. System Sasyk - Shahany -

[1] http://wwf.panda.org/about_our_earth/ecoregions/ecoregion_list/

Alibei - Burnas gained international status of wetlands as a place of settlement of waterfowl and are included within then Ramsar Convention on the protection of wetlands.

Annex 4: List of international conventions, agreements and protocols which directly or indirectly link to the current project

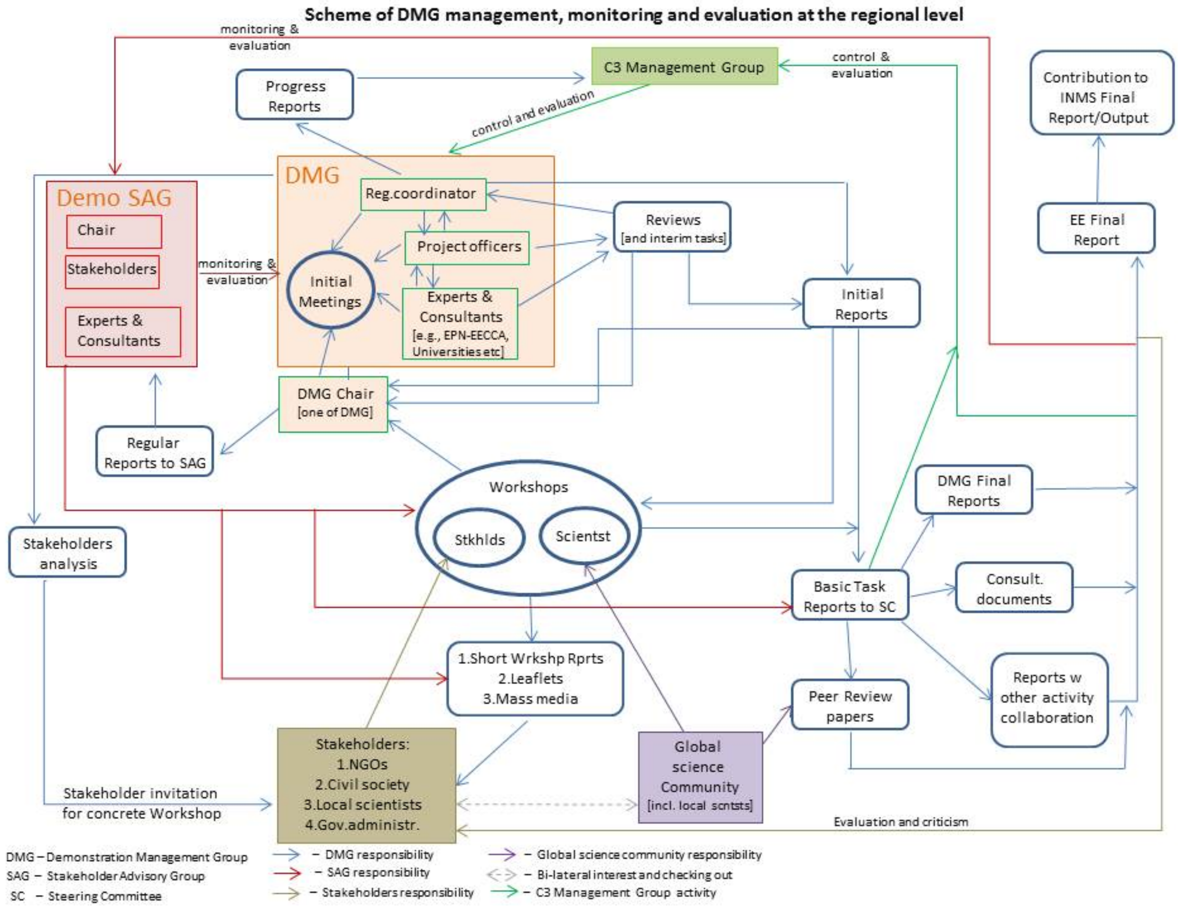
("+" means signed/ ratified by Ukraine)

Convention/protocol/declaration	Signed	Ratified
Convention on the Conservation of European Wildlife and Natural Habitats	+	+
The Convention on Wetlands of International Importance, especially as Waterfowl Habitat	+	+
Protocol on Civil Liability and Compensation for Damage Caused by the Transboundary Effects of Industrial Accidents on Transboundary Waters	+	-
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	+	+
The Stockholm Convention on Persistent Organic Pollutants	+	+
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	+	+
Convention on biological Diversity	+	+
Nagoya Protocol On Access To Genetic Resources And The Fair And Equitable Sharing Of Benefits Arising From Their Utilization To The Convention On Biological Diversity	+	-
Convention on the Conservation of Migratory Species of Wild Animals	+	+
The Convention on International Trade in Endangered Species of Wild Fauna and Flora	+	+
European Landscape Convention	+	+
The Framework Convention on the Protection and Sustainable Development of the Carpathians (Carpathian Convention)	+	+
United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa	+	+
Convention on access to information, public Participation in decision-making and access to Justice in environmental matters (done at Aarhus, Denmark, on 25 June 1998)	+	+
Convention on the Protection and Use of Transboundary Watercourses and International Lakes	+	+
Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses	+	+

and International Lakes		
Convention On The Protection Of The Black Sea Against Pollution	+	+
Convention on cooperation for the protection and sustainable use of the danube river (Danube river protection convention)	+	+
Convention regarding the regime of navigation on the	+	+
Cartagena Protocol On Biosafety To The Convention On Biological Diversity	+	+
The Nagoya – Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety	+	+
The Framework Convention on the Protection and Sustainable Development of the Carpathians (Carpathian Convention)	+	+
Convention on the Conservation of Migratory Species of Wild Animals	+	+
Agreement on the Conservation of Populations of European Bats	+	+
Agreement on the Conservation of African-Eurasian Migratory Waterbirds	+	+
The Convention on the Protection of the Black Sea Against Pollution	+	+
The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)	+	+
Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area	+	+
Pan-European Biological and Landscape Diversity Strategy (PEBLDS)	+	+
The Convention on Long-range Transboundary Air Pollution	+	+
Protocol concerning the Control of Emissions of Nitrogen	+	+
Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)	+	+
Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level	-	-
Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes	+	-
United Nations Framework Convention On Climate Change	+	+
Kyoto Protocol To The United Nations Framework Convention On Climate Change	+	+
The Vienna Convention for the Protection of the Ozone Layer	+	+

The Montreal Protocol On Substances That Deplete The Ozone Layer	+	+
Convention on Environmental Impact Assessment in a Transboundary Context	+	+
Convention Concerning the Protection of the World Cultural and Natural Heritage	+	+

Annex 5: Detailed organigram of the activities and groups within the demonstration area



INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 17f (Activity 3.1f)

West Europe Demonstration

Summary

The regional demonstration in West Europe will cover the case of ‘Developed regions with excess reactive nitrogen’, but will be fully financed through co-financing, i.e. it will not receive any GEF funds. The work will take place using the same methodology as that applied for the five GEF funded regional demonstrations as far as is possible with the use of the co-finance available. The inclusion of this demonstration will also facilitate the inclusion of expertise from West Europe and allow vital knowledge transfer on the use of a full nitrogen approach as applied in this region. It is expected that additional input from a North American demonstration may also be developed during the course of the project.

Contents

Abbreviations

Acronym	Full Title
ADEME	French Agency for Environment and Energy Management
BASF	BASF the Chemical Company, originally: "Badische Anilin und Soda Fabrik"
CBD	United Nations Convention on Biological Diversity
CEMA	European Federation of Agricultural Engineers
CIEMAT	Research Center for Energy, Environment and Technology, Madrid, Spain
CLRTAP	UNECE Convention on Long-Range Transboundary Air Pollution
CoP	Community of Practice
COPA-COGECA	European Farmers and Cooperatives Organization, , established from the "Comité des organisations professionnelles agricoles" and the "Comité général de la coopération agricole de l'Union européenne"
CSO	Civil Society Organization
DMG	INMS Demonstration Management Group (for each regional demonstration)
ECLAIRE	Effects of Climate Change on Air Pollution and Response Strategies for European Ecosystems, and EU collaborative research project
EMEP	European Monitoring and Evaluation Programme, established under the UNECE LRTAP Convention
ENA	European Nitrogen Assessment
EPMAN	Expert Panel on Mitigation of Agricultural Nitrogen of the TFRN
EPNB	Expert Panel on Nitrogen Budgets of the TFRN
EPNF	Expert Panel on Nitrogen and Food of the TFRN
EU-NEP	European Union Nitrogen Expert Panel
FE	Fertilizers Europe - the European fertilizer industry association
FFCUL	Fundacao da Faculdade de Ciencias da Universidade de Lisboa, Portugal
HTAP	UNECE Hemispheric Task Force on Air Pollution (under the LRTAP Convention)
IFOAM	International Federation of Organic Agriculture Movements
IGBP	International Biosphere-Geosphere Programme
IGO	Inter-Governmental Organization
IMO	International Maritime Organization
INI	International Nitrogen Initiative
INMS	International Nitrogen Management System
INRA	National Institute for Agronomic Research, France
IOC	Intergovermental Oceanographic Commission of UNESCO
ISA	Instituto Superior de Agronomia, University of Lisbon, Portugal
LOICZ	Land Ocean Interactions in the Coastal Zone, an IGBP project
LRTAP Convention	The Convention on Long-range Transboundary Air Pollution, established under the auspices of the UNECE
MSFD	Marine Strategy Framework Directive of the European Union
NEA	North East Atlantic
ND	Nitrates Directive of the European Union
NGO	Non-Governmental Organisation

NinE	Nitrogen in Europe - a networking project of the European Science Foundation which prepared the ENA
N2O	Nitrous oxide - a greenhouse gas and ozone depleting substance
NH3	Ammonia - a constituent of biological systems and an air and water pollutant
NH4	Ammonium - a constituent of biological systems and a water and air pollutant
NO	Nitric oxide - an air pollutant
NO2	Nitrogen dioxide - an air pollutant
NO3	Nitrate - a water and air pollutant
NOx	Nitrogen Oxides (the sum of NO and NO2 concentrations)
Nr	Reactive nitrogen
NUE	Nitrogen Use Efficiency
OECD	Organization for Economic Cooperation and Development
ONW	Our Nutrient World - a report produced for UNEP by GPNM and INI
OSPAR	Oslo and Paris Commission - the Convention for the Protection of the Marine Environment of the North-East Atlantic
PCH	PigCHAMP Pro Europa S.L., Spain
SDG	Sustainable Development Goal
TFRN	UNECE Task Force on Reactive Nitrogen (under the LRTAP Convention)
UNECE	United Nation Economic Commission for Europe
UNEP	United Nations Environment Programme
UPM	Technical University of Madrid
UPMC	University Pierre and Marie Curie, Paris
WFD	Water Framework Directive of the European Union
WGSR	Working Group on Strategies and Review of the UNECE LRTAP Convention

1 Introduction to the WEST EUROPE Demonstration in 'Towards INMS'

1.1 Background and Context

Agriculture is currently at a crossroad of several controversies related to the need of feeding a growing population with increasing qualitative requirements, while preserving biodiversity and environmental resources, including ground- and surface water. There is an urgent need to better understand how the organization not only of agricultural activity but of the whole agro-food system affects the functioning of the environmental system at small and large scales, and across a large range of bio-climatic regions of the world, taking into account the diversity of the different agro-food systems (Mueller et al 2012), and the need to safeguard them as far as they are able to meet the local human needs (De Schuter, 2010; Fader et al 2013; MacDonald et al 2013).

The challenge is therefore to carry out in parallel local studies of the agricultural systems, taking into account the specificities of pedo-climatic conditions (e.g. in Europe temperate *vs.* Mediterranean systems), and at the same time to develop a summarizing, unifying and comparative view of how the whole system is working.

Using nitrogen (N) as a metric to describe the agro-food system greatly helps in providing a generic representation of common features of all agro-food systems, i.e. the biogeochemical interrelationships between crop farming, livestock husbandry and human nutrition (Billen et al., 2012). By essence, the biogeochemical approach should not be limited to agricultural soils but should encompass the whole nutrient cascade from agro-systems to the coastal seas, through the aquatic continuum (including the issues of groundwater contamination and eutrophication), at the local, regional or global scale. Models representing the interactions between agro-food systems and water quality in terms of nutrient transfer and concentration at the regional scale have been developed and are now operational for exploring various scenarios of possible changes in the agro-food systems and their consequences in terms of eutrophication processes (Thieu et al 2009; Thieu et al 2010; Lancelot et al 2011; Passy et al 2013).

Such a description of nutrient fluxes can easily be completed by complementary analysis of N dynamics both in the soil, atmosphere and hydrosystems through measurements of (e.g.) mineral N in soil and water as well as N gaseous compounds such as NH_3, N_2O and NO_x.

As an unfunded demonstration we will use our existing research efforts to support the development of a regional demonstration in West Europe. Our approach will be two-fold, on the one hand it will consist of a comparative synthesis of field measurements conducted at the scale of two experimental watersheds (about 100-360 km²) respectively located in temperate and Mediterranean climate zones. The data acquired at that scale will then feed the analysis of the water-agro-food system of regional watersheds in Europe, along the temperate to Mediterranean climatic gradient, from the Rhine to the Guadalquivir. The second approach involves utilising the results of the EU NitroPortugal project which will lead to the basis for the first Portuguese Nitrogen Assessment. Linking with this activity will allow the nitrogen issue to be viewed in a Southern European context. Whilst both these activities are a significant start to a regional demonstration activity, due to the nature of the core projects and partners involved in the work, much of the output from the former activity will relate to the water system and that from the

latter activity to only one country. However in the context of the demonstration and as the INMS project progresses we anticipate that we will involve studies and experts to place this study in the wider context of the nitrogen cycle and the aims of the demonstration activities as a whole.

North Atlantic Watershed Activities

Mathematical models will play a major role in the project as the required tools for scaling up and establishing the link between agro-food systems and aquatic systems.

The aims will consist of defining and measuring innovative indicators of agronomical and environmental performances of cropping systems, based on field observations, inquiries and experimental work conducted at the scale of instrumented watersheds located respectively in a gradient of temperate to Mediterranean pedoclimatic regions in the European Atlantic Façade. The tool “Graphs” has been developed which documents agricultural activity and calculates its impact on environmental quality in terms of surpluses, e.g. budgeting nutrient surface soil balances. This tool can be applied at a variety of scales, depending on the agricultural statistics data (administrative territories such as department of provinces, regions, countries).

The Riverstrahler model (Billen et al 1994; 1999; Garnier et al 1995;2002; Thieu et al 2009; Passy et al 2013) allows this surplus to be taken into account as a diffuse source, hence allowing the calculation of the fate of nutrients issued from agriculture through their cascade along the river networks down to the coastal zones. Riverstrahler is a biogeochemical model of drainage networks representing the nutrient cascade in the aquatic continuum (Riverstrahler model and its PyNuts plateform for calculating the constraints of the model at a large scale, e.g. the north Atlantic façade).

This modelling coupling will allow the quantification of nutrient transfers from agro- to hydrosystems. This approach will incorporate the knowledge acquired at the scale of experimental catchments to that of the temperate-Mediterranean gradient (thus beginning a regional scale comparison).

Portuguese Nitrogen Assessment

In the context of the NitroPortugal project, several workshops are planned, leading towards the basis of a first Portuguese Nitrogen Assessment. These include knowledge transfer regarding modelling nitrogen emission and deposition, identification of sensitive natural habitats and the modelling of nitrate leaching to improve water quality. Further activities will include assessing the current state of knowledge and gaps to instigate a national scale assessment including biodiversity loss in semi-natural habitats in Portugal.

The project will also allow the generation of a common database for nitrogen in Portugal, allowing for further synthesis on the current state of the environment. Stakeholder engagement is also an important part of the strategy and resources will be devoted to both stakeholder consultation and policy dissemination activities. Barriers to change will also be assessed and utilised to develop and communicate relevant policy solutions.

1.2 Environmental threats, root causes and barrier analysis

The nitrogen cascade, with values for EU-27 and the world is shown in Figure A17f2, this highlights the sources of nitrogen emissions from both agriculture and combustion and how they cascade through the environment. This cascade leads to a number of threats, which have been summarised (as noted in Section 2.4 of the proposal document) in the European Nitrogen Assessment (Sutton et al. 2011), as five key threats (see Figure A17f2), for Water Quality, Air Quality, Greenhouse Gas Balance, Ecosystems Biodiversity and Soil Quality (WAGES). Figure A17f3 further highlights the impacts of nitrogen use in agriculture on the environment, showing increases in fertiliser use and nitrate impacts in the Seine Basin and aquifers.

As nitrogen has a long residence time in some of the environmental compartments (soils, vadose zones, aquifers, etc.), an equilibrium can be reached only several decades after the onset of industrial agriculture, and we can still expect further nitrogen contamination of the ground- and surface waters. Whilst many policies exist in Europe to address environmental pollution from agriculture and industry, the European Nitrogen Assessment noted that the lack of a holistic approach to the nitrogen cascade leads to risks of contradictory effects of policies dealing with different aspects of the problem. If an integrated approach to nitrogen management is adopted it can lead to more effective policies, with less trade-offs. However, gaining political consensus on how to achieve improvements is difficult (Leridon & de Marsily, 2011; Swinnen & Squicciarini, 2012).

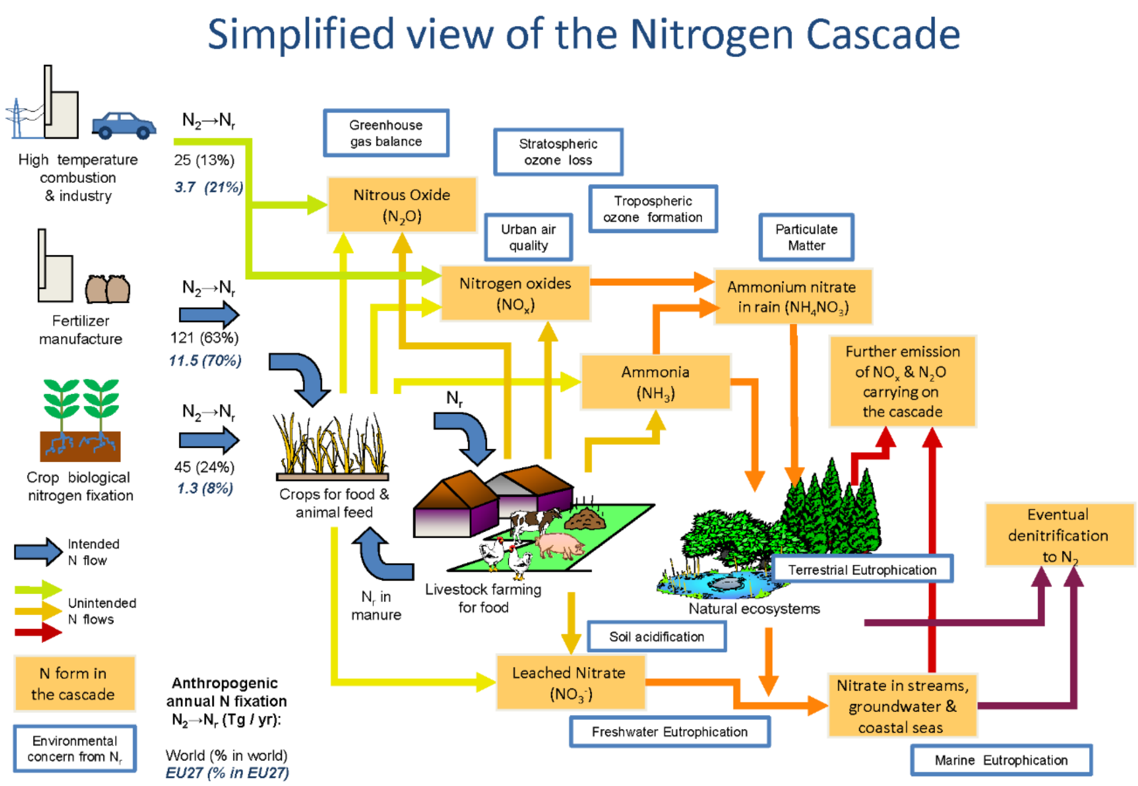


Figure A17f1: *Simplified view of the nitrogen cascade, highlighting the major anthropogenic sources of reactive nitrogen (N_r) from atmospheric di-nitrogen (N_2), the main pollutant forms of N_r (orange boxes) and nine main environmental concerns (blue boxes). Estimates of anthropogenic N fixation for the world (Tg/yr for 2005, in black) are compared with estimates for Europe (Tg/yr for 2000, in blue italic). Blue arrows represent intended anthropogenic N_r flows; all the other arrowsare unintended flows.*

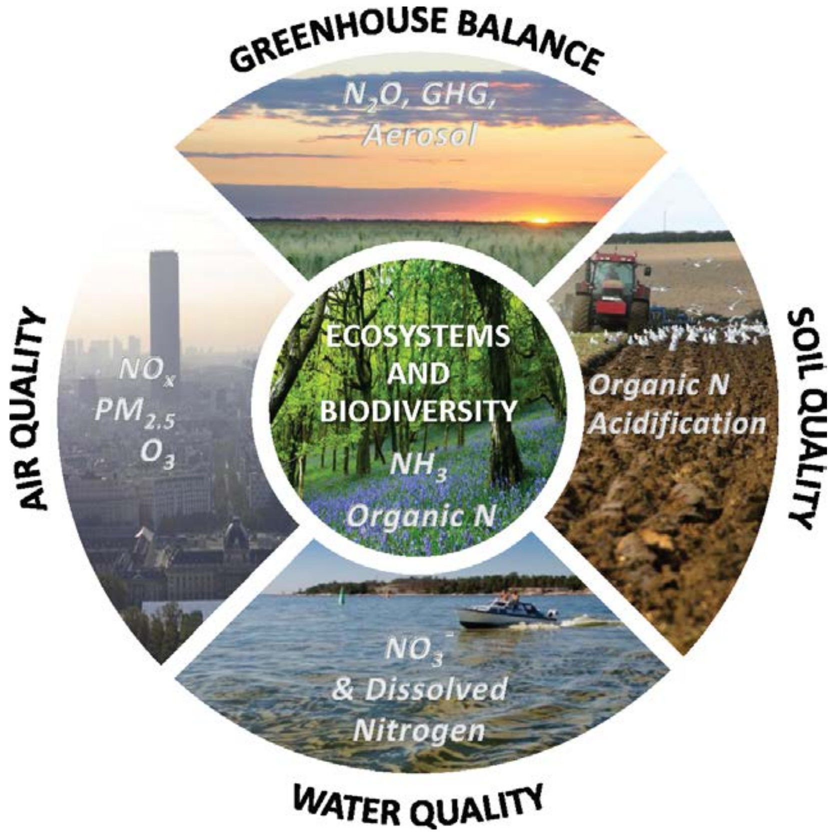


Figure A17f2: *Five key threats of excess nitrogen in the environment, which can be summarized under the acronym WAGES: Water, Air, Greenhouse balance, Ecosystems and Soils (from Our Nutrient World). In addition, the INMS Pump Priming Workshop (Edinburgh, May 2015) emphasized the importance of nitrogen for both Food and Energy Security.*

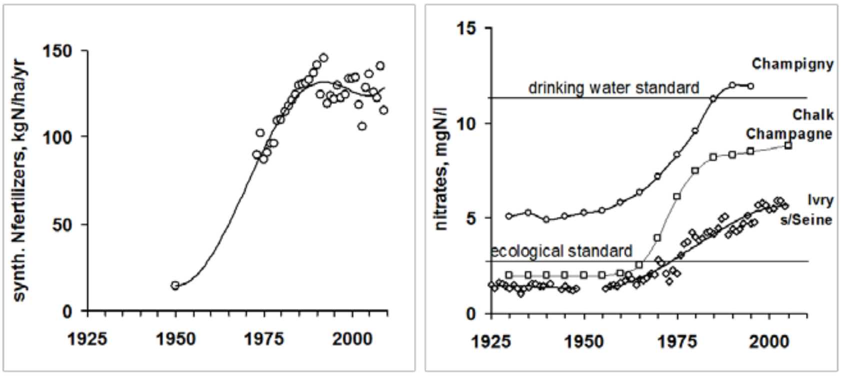


Figure A17f3: *Long-term synthetic fertiliser use (kgN/ha/yr) in the Seine Basin (left) and nitrate concentrations (mgN/l) in two major aquifers and in the Seine River upstream from Paris, France (right).*

Regarding environmental damage from agriculture, discussions are converging on the importance of tightening the feedback loop between production and consumption so as to achieve sustainability (Sundkvist et al., 2001; Davis et al., 2012). The regional scale allows a good level of coherence for decision and management, i.e. a level at which implementation of measures is relatively possible.

1.3 Institutional, sectoral and policy context

In Europe, a wide range of organisations are involved in N related issues, from the European Union, the United Nations Economic Commission for Europe, through national environment and agriculture ministries, regional agriculture extension services, to NGO environmental associations, water related agencies, national and regional research networks. Relevant policies in the EU are the Common Agriculture Policy (CAP), the Nitrates, National Emissions Ceilings, Integrated Pollution Prevention Control (IPPC) and Water Framework Directives. In relation to agricultural activities, the IPPC provides guidance on Best Available Techniques in the intensive rearing of poultry and pigs (BREF documents).

In the UNECE the Convention on Long Range Transboundary Pollution (CLRTAP) is the most relevant, with the Gothenburg Protocol Annexes related to NOx and Ammonia emissions. Under the Working Group on Strategies and Review of CLRTAP, sits the Task Force on Reactive Nitrogen. The Task Force has the long-term goal of developing technical and scientific information, and options which can be used for strategy development across the UNECE to encourage coordination of air pollution policies on nitrogen in the context of the nitrogen cycle and which may be used by other bodies outside the Convention in consideration of other control measures. It has supported the revision of Annex IX of the Gothenburg Protocol (Ammonia emissions from agriculture) and revised both the Guidance Documents on Ammonia Abatement and the Framework Code on Ammonia Abatement, which support the implementation of the Gothenburg Protocol at national level.

Private sector organisations of relevance include agricultural organisations such as the National Farmers Union (UK), COPA-COGECA (European Farmers & European Agri-Cooperatives) and the fertiliser industry, Fertilisers Europe (FE), Yara International ASA, BASF and representing agricultural machinery in Europe (CEMA). NGO's and civil society groups include the World, Wide Fund for Nature (WWF) and the Planetary Boundary Initiative (PBI).

2 Baseline for the WEST EUROPE Demonstration in 'Towards INMS'

2.1 Baseline analysis

As noted earlier, the West Europe demonstration will make use of existing ongoing work, to support the regional demonstration activities as far as is practicable along with sharing experiences on their work with the rest of the Component 3 network. In this context then, the baseline for the ongoing work is focused in several areas:

The SeasEra project (Emosem 2013-2015), was conducted on the North European Atlantic coastline and has led to an update of the Riverstrahler model to allow implementation for a large number of watersheds. The Riverstrahler model has been indeed embedded in a powerful structure of modern database management tools allowing the application of this new modelling approach to a large number of basins for which a coherent and homogeneous database is available.

This Emosem domain from the Rhine to the Guadalquivir, will be one of the scale in WEST EUROPE Demonstration in 'Towards INMS'. The INMS project would allow to continue to refine the description of natural and anthropogenic constraints (domestic and diffuse agricultural sources), leading to robust validations of the Riverstrahler model, on the basis of which scenarios can be explored.

Several years of experimental studies have been carried out in terms of nitrogen cascade. The ADEME EFEMAIR-N_2O project (2013-2015), is dedicated, on the basis of to a wide set of soil microbial process lab experiments, and field observations in a north-south gradient in France, to mathematically formalize greenhouse gas emissions (N_2O) in any ad hoc modelling tools in the perspective of its possible mitigation. The ANR-Escapade project (2013-2016) will model the N-cascade, from the farm scale, taking into account the agricultural practices, to small watersheds; in addition to N_2O measurements, NH_3 is also investigated. ABAC project (2013-2016), supported by the Seine-Normandy Water Agency, Eau de Paris and the Ile-de-France Region, have allowed to equip a number of farming systems in the temperate oceanic half north of France, for documenting environmental impacts of cropping organic systems on nitrate lixiviation. For Mediterranean conditions, National Spanish projects such Agrisost (2010-2014), Agrisos II (2014-2018) and NEREA (2013-2016) for exploring new approaches to efficient use of N for sustainable agriculture, as well as the EU Project ÉCLAIRE project (2011-2015), will provide crucial scientific basis for elaborating scenarios for a water friendly ecological agriculture. The Spanish projects also explore the possible influence of tropospheric ozone on crop nitrogen use efficiency. The Spanish project EDEN analysed nitrogen atmospheric deposition in Mediterranean environments with particular attention on dry deposition estimation.

The NitroPortugal project started in January 2016, however it is designed to maximise existing science-policy support networks and therefore connects with the work of the UNECE Task Force on Reactive Nitrogen, through the inclusion of the UK and Danish Co-chairs, based at the Centre for Ecology and Hydrology and Aarhus University respectively.

2.2 Gaps

What are main gaps in the region with respect to:

N policies

The mitigation of point sources has been an efficient way to reduce the amount of nutrients transferred to the aquatic system, especially for phosphorus, as nitrogen is essentially issued from diffuse agricultural sources. However despite the recent improvement of wastewater treatment plants in the NEA domain, several coastal zones are the fate of eutrophication, causing environmental and economic problems (e.g. green tides in Brittany, toxic algae poisoning shellfish, mucus accumulation in the North of France, Belgium and the Netherlands). Even though all wastewaters would fully comply with European requirements. (Urban Wastewater Directive, Directive 91/271/EEC, EU-WFD, 2000) in the nearby future, additional measures should be devoted to a sustainable agriculture for achieving a good water quality of continental and marine water masses.

N practices

Despite, huge effort have been made by farmers, for reducing the N inputs, splitting these inputs in time, and by the authorities in greening the CAP, agricultural systems are not planned to change deeply. Several research works have clearly showed in the world the benefit from alternative agriculture, based on longer crop rotation, introducing legume in the head of the rotation, reducing GHG emission and leaching; however, in addition to lobbies in the economic world, a part of scientists are clearly advocating for intensification of agriculture for feeding the world whereas others have shown sustainability of alternative management of the water-agro-food system.

Scientific understanding

Since the WWII, massive mineral nitrogen fertilizers have been introduced for an intensification of agriculture leading to a disconnection between cattle breading and cereal cropping and a specialization of territories. Whereas such intensification has been largely studied (improvement of seed variety, new fertilizer technologies, increased of yield, etc.), the impact on the environment (water and soils quality, biodiversity, human health, etc.) has not been studied, as was well the performance of alternative agriculture (e.g. organic which has among its specificities avoiding the use pesticide as well as synthetic fertilizers). The reduction of plant nitrogen use efficiency induced by ozone is recently being highlighted but scarce information is available. Even less knowledge exists on the effects of ozone on soil N_2O emissions.

Funding for these

In most of the member states funding in the field of agriculture are devoted to research and researchers who have been involved for 50 years in the agriculture intensification. Despite the urgent recognized need for a sustainable agro-food system, the economic crises in Europe does not allow research for a deep changing agricultural system but rather improving the one in place. Large support is also dedicated to research in climate change, but investigating the water-agro-food system in a climatic gradient has to be done, e.g. in the in WEST EUROPE Demonstration in 'Towards INMS'.

2.3 Stakeholder analysis

In the WEST EUROPE Demonstration main producers are:

- UK: WAIC (Agricultural Industries Confederation)
- The Netherlands: VKP (Vereniging van Kunstmest Producenten)
- Belgium: BELFERTIL
- Germany: IVA (Industrieverband Agrar e.V.)
- France: UNIFA (Union des Industries de la Fertilisation)
- Spain: ANFFE (Asociación Nacional de Fabricantes de Fertilizantes)

In the WEST EUROPE Demonstration main users of N are mostly farmers but also consumers as they are drivers of the entire agro-food system.

Main stakeholders

Water managers are particularly attentive to environmental losses under the form of nitrates which contaminate most of the aquifers and lead to the closure of wells for drinking water production.

Air quality managers (Ministry of Environment or equivalent) need to guarantee that emissions ceilings and air concentrations standards are not exceeded.

An important group of consumers are aware of environmental impacts of food production and consumption as well as of impacts on human health of certain practices (e.g. increasing animal protein intake). Therefore, consumers associations and NGOs will play a role as a stakeholder here.

Role of the government in N management

Application of the environmental EU directives (WFD) as well as other regarding to the performance of the agro-food system (e.g. food waste reduction). Implementation of the new EU legislation on organic farming will have implications on N fertilizing.

Role of the private sector (including farmers)

Some cooperatives, influenced by the industry, tend to persuade farmers not to change their practices, arguing that they will decrease their yield, and hence their income.

Role of the NGOs/Civil Society Organisations

NGOs such as farmer federation for organic agriculture organize meetings with farmers and the civil society to make all aware of the environmental problems, provide success stories of conversion, put a cost on the conversion process and accompany farmer in their new system and practices.

3 Project Description for the WEST EUROPE Demonstration in INMS

3.1 Strategy

The DMG for West Europe will characterise the agronomical and environmental performances of cropping systems using several indicators and integrative approaches at the scale of the two contrasted experimental catchments, with the aim of upscalling the approach to North European Atlantic domain. Links will also be made with the NitroPortugal project, which will bring experts together from across Europe to prepare the basis for a nitrogen assessment for a Southern European country – Portugal.

North Atlantic Watershed Activities

The methodology will be organised as follows:

(1) A soil C-N coupling index, defined as the ratio of organic carbon inputs (as crop residues and non-harvested underground production plus organic fertilizers) to the total N (organic and inorganic) inputs to the soil, tells about the importance left to microbial processes in the soil nutrient metabolism. P content in soils will be also documented to determine a possible N-P imbalance.

(2) Emission factor of ammonia (NH_3) and nitrous oxide (N_2O) will be used in relation (i) to agricultural soil surface (ha) (ii) to crop yield (i.e. yield- scaled N_2O and NH_3 emissions).

(3) The cropland N balance, i.e. the difference between total N inputs (mineral fertilizers, manure, symbiotic N fixation and atmospheric N deposition) and export (through harvest), integrated over the whole cycle of crop rotation, provides (i) an integrated estimate of productivity, in terms of protein produced; (ii) the potential for environmental losses of N; (iii) an estimate of the degree of external dependency of the cropping system with respect to the sources of N fertilization. A P balance will be also established.

(4) Potential N leaching index based on long term monitoring from experimental site observatory, as agriculture response toward surface water will be analysed.

(6) Modelling approach for soils (e.g. STICS, DNDC, etc.) validated on the experimental data in the range of temperate to Mediterranean conditions, will be used for exploration of N, C, N_2O, NH_3, water cycle in a variety of soils. For nitrate leaching, these results will be compared with the GRAFS results of leached surplus.

All these results will feed both the budgeting and modelling approaches (e.g. the watershed Riverstrahler biogeochemical model). Once validated, the model will be used to explore scenarios, which will have to be implemented to the modelling approach.

1. At this stage, as the whole domain do not still fully comply with European requirements in terms of wastewater treatments, a first scenario will involve a spatially explicit implementation of the Urban Wastewater Directive, (Directive 91/271/EEC) implying:

   • The Collection and treatment of waste water in all agglomerations of >2000 inhequ;

   • Upgrading of wastewater treatment plant for non-compliant agglomerations, taking into account the sensitivity of receiving areas.

   This scenario also includes an additional reduction of the per capita human emissions of P, considering a complete ban of phosphorous in both laundry powders and dishwasher detergents, based on the Regulation (EC) No 648/2004 concerning the use of phosphates and other phosphorus compounds in household laundry products.

2. **Reasoned agricultural practices**. At least in most vulnerable areas, considerable efforts have been devoted since the last decades to adapt the level of fertilization to the needs of crop growth. The current situation described by the nitrogen soil balance of the different agricultural regions of NEA thus probably reflects the lower limit of the level of N surplus (defined as the difference between total N inputs to the soil and export of N with the harvest) which can be achieved without major change in the current cropping systems and yield objectives. The only lever which could lead to reduction of N leaching consists on the introduction of catch crops preventing bare soils before spring crops. Such measure has indeed been demonstrated to significantly reduce the fraction of N surplus of arable land being leached during the drainage period, thus its presence is taken into account for the adjustment of fertilization of the succeeding crop. The limit of the efficacy of this measure is set by the frequency of spring crops in the cultural rotation cycle. For this reason, we found that, as a mean over all regions of the domain, only a 30% decrease of lixiviation can be expected from the generalization of catch crop implementation.
3. **Radical change in the agro-food system (LocOrgDem).** N losses to hydrosystems can be viewed as the direct consequence of the specialization and opening of territorial agro-food systems. Reshaping territorial N fluxes toward more connection between crop production and livestock farming, as well as between agriculture and local human food consumption is a radical option for reducing N contamination of water resources and fluxes to the sea. The construction of this scenario for the domain involved the following steps.
   - Revision of human diet, with a shift towards more vegetal and less animal protein ingestion (inverting the current 35% vegetal and 65 % animal protein proportions) and a reduction of wastage.

- Adjustment of livestock numbers in each agricultural region to local human requirements of animal proteins, within the limits of 0.1to < 0.6 LU/ha agricultural land and no reduction of livestock size by more than a factor of 3.
- Organic cropping systems with long and diversified rotations involving legumes are established everywhere. N fertilization is limited by the local availability of manure. The resulting yield is calculated assuming the same yield vs fertilization relationship as the one currently observed.

Incremental reasoning, how this will contribute to the overall INMS project etc.

The nutrient cascades (C, N, P), the structure and quality of soils will be analyzed for contrasted catchment scales in this temperate-Mediterranean gradient, on the basis of field experimental results and experimental simulations for a range of different agronomical systems (from organic to conventional). Indicators will be implemented at larger scales, after they have been tested locally. From plots to catchments, the linkage between agricultural practices, the role of soil as filter, and surface water transfer will allow a detailed understanding of the mechanisms behind the nutrient cascades, for which a typology of C, N, P losses to the hydrosystems will be established.

The scenarios proposed above as well as others that will be constructed during the project should make aware politics, stakeholders and citizens that agricultural practices must be reformulated and the agro-food systems rebuilt, even in that part of the world of rich countries (most of them with too-much N areas), with strong regulations, where nevertheless agricultural and environmental problem has been disconnected.

Portuguese Nitrogen Assessment

The activities related to developing the basis for the first Portuguese Nitrogen Assessment, as supported by funds from the NitroPortugal project will be primarily the organisation of workshops for expert knowledge exchange and training, the sharing of data and also staff exchange. These activities can be used to support the wider development of a West Europe demo, bringing of course a wealth of data on Portugal and therefore also the issues associated with Southern Europe. Experience from the development of the basis for a first Portuguese Nitrogen Assessment will also be of use for the funded demonstration areas, as they will be developing their own national assessments where practicable and will therefore be facing similar challenges in some cases.

3.1.1 Linkages with GEF and non-GEF interventions

See § 2.1.

3.2 Project Sub-components and activities

The activities developed by the **DMG – W Europe group** within the Activity 3.1 Design common methodology & conduct regional demos to refine regional Nr assessments and improve understanding of regional N cycle will essentially consists in two local instrumented case-study sites in a temperate and a Mediterranean zone (Figure 2). This will go alongside the more focused efforts in Portugal from the NitroPortugal project.

The approach for the watershed activities, of the development at local scale will offer the opportunity to experimentally test a number of hypothesis about the agronomical and environmental performances of low input agricultural systems compared with current, conventional agricultural systems, owing to field facilities available in the two experimental sites (Garnier et al 2014; Sanz-Cobena et al 2012; 2015), chosen for being representative of cropping systems of temperate and Mediterranean Europe (Figure 2). Other results from INRA experimental sites (Figure 2), could feed this project.

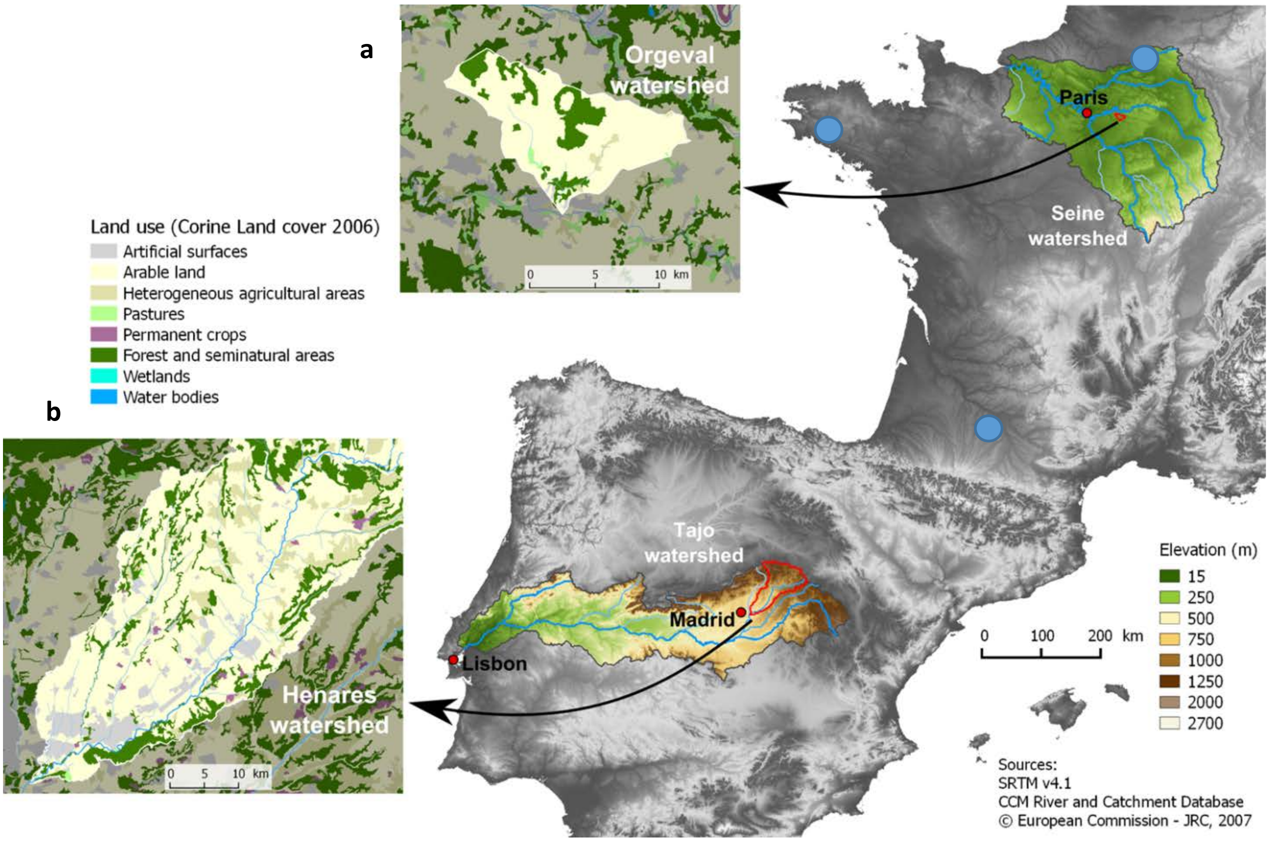


Figure A17f4 *The two instrumented sites: a. the Orgeval catchment (Brie, France) 100km²; b. the Henares catchment in the Tagus river Basin (Spain), 360 km². potential other site study in the temperate-Mediterranean gradient.*

Feeding a regional analysis of the N cycle implies to be able to produce references corresponding to the scenarios studied, both in term of localization and agricultural practices. Practically, this is only possible through the use of models, as experimental references are still sparse and specific.

3.2.1 Analyzing the agronomical performance of alternative agricultural systems.

The official European organic farming specifications, or their national counterparts, leave room for a large diversity of practices according to the pedoclimatic or socio-economical context. There are few available statistics, if any, providing a census of this diversity in European countries. This is mainly because organic farms are, in most cases, a minority and are very heterogeneous. INMS project will take stock of the diversity of practices of organic cropping systems in the different regions covered by the members of the consortium. The study will include cropping systems, associated or not with livestock farming, as well as market gardening and fruit growing, particularly important in the Mediterranean region.

As an *indicator of agronomical and environmental* performance of cropping systems, the surface soil balance and the soil quality will be used. The approach consists of assessing, through detailed questionnaires of individual farms, nutrient inputs to arable soils from organic fertilizers, biological N fixation and atmospheric N deposition, as well as the total export of crop N harvested, integrated over the whole rotation cycle. This provides (i) an estimate of productivity, through the integrated crop yield in terms of protein produced; (ii) the potential for environmental losses of N (iii) an estimate of the degree of external dependency of the cropping system with respect to the sources of N fertilization (organic fertilizers from outside the farm versus biological fixation). In addition, an assessment of soil management practices and soil quality will be carried out.

Further, there are certain organic crops aimed at high-added-value markets. The agronomical performance of organic systems must therefore consider quality aspects of the produced goods. For this reason, besides gathering information from the surveys, we propose, as part of this, a limited set of analyses to generate quality indicators for certain organic crop/products. This will include (e.g. pH and unsaturated fatty acids for olives; sugar content of grapes for wine making; protein content of grains for bread flours).

A common questionnaire will be established. The data gathered from surveys conducted along these lines among a large sample of organic farms (>100) in the studied areas will provide solid grounds to compare organic farming practices across Europe. The relative performances of organic farming vs. those of conventional cropping systems in the same areas will be also assessed, as revealed from the N balance calculated from available national statistics.

3.2.2 Experimental determination of N losses to the environment

Besides pesticide dispersal, N losses from soil to the atmosphere (as GHG, NH_3, NO_x) and to the hydrosphere (as NO_3^-) are the main environmental problems caused by agricultural practices. The losses of organic vs. conventional farming practices remain a matter of controversy and therefore require careful experimental assessment across a wide gradient of either pedoclimatic situations or available N amounts for crop.

INMS project will quantify N losses as N_2O, NO_3^-, and NH_3 for a variety of organic farming system (OFS) management applications. The project will be conducted on farms taking into account their complete technical itinerary and experimental plots.

A number of technical itineraries in farms and experimental plots have been already identified:

1. ABAC network of farms and experimental plots in the Northern France and the Parisian basin;
2. Agrisost network of experimental sites in Madrid region.

Direct emissions of nitrous oxide will be evaluated at the plot scale using chamber techniques (static chamber, manual or automatic). Special attention will be paid to i) the role of alfalfa in N_2O emissions, especially at the time of the tillage, 2 or 3 years after the beginning of the cropping rotation cycle in organic systems, and also ii) legume intercropping, catch/cover crops, etc. Methane and CO_2 are currently measured simultaneously with N_2O. iii) The effect of residue application to soils, including crop residues (straw or pruning residues) and agro-industry residues (olive mill waste, winery waste).

Nitrate leaching will be measured within all of the organic cropping systems (from simple rotation to 7-9 years crops depending on the regions) in a number of plots/farms differing by the date of their conversion, their typical practices, soils characteristics, etc. (e.g. 500 suction cups are already monitored by UPMC).

Ammonia volatilization will be measured in some cases using the micrometeorological technique Integrated Horizontal Flux method (IHF), which allows the calculation of NH_3 volatilization from medium (e.g. 1 ha) sized plots.

3.2.3 Modelling agronomical performance and nutrient losses of cropping systems

In close connection to above activities, INMS will model the **organisation of the agro-food system** of the same territorial units (regional watersheds), using the GRAFS approach describing the interrelationships between agriculture, livestock breeding and human nutrition based on nitrogen (protein) fluxes. The estimation of trade exchanges between territorial units will be an important aspect of the description, as it is a key for the organization of the current and very specialized agro-food systems, as well as for any future alternative scenarios. In particular, a reconnection of animal breeding with cropping will be explored, combined with a reduction of animal protein in human diet.

We developed a conceptual and **G**eneric **R**epresentation of any regional **A**gro-**F**ood **S**ystem (GRAFS) quantitatively relating their four main components (Figure 3): (i) arable cropland with their characteristic crop succession optionally including a fraction of nitrogen-fixing crops; (ii) permanent or semi-natural meadows involved in livestock feeding; (iii) livestock; (iv) the human population. Export of nitrogen through the harvest of arable land should be returned to the soil through fertiliser or manure application, symbiotic nitrogen fixation and atmospheric deposition.

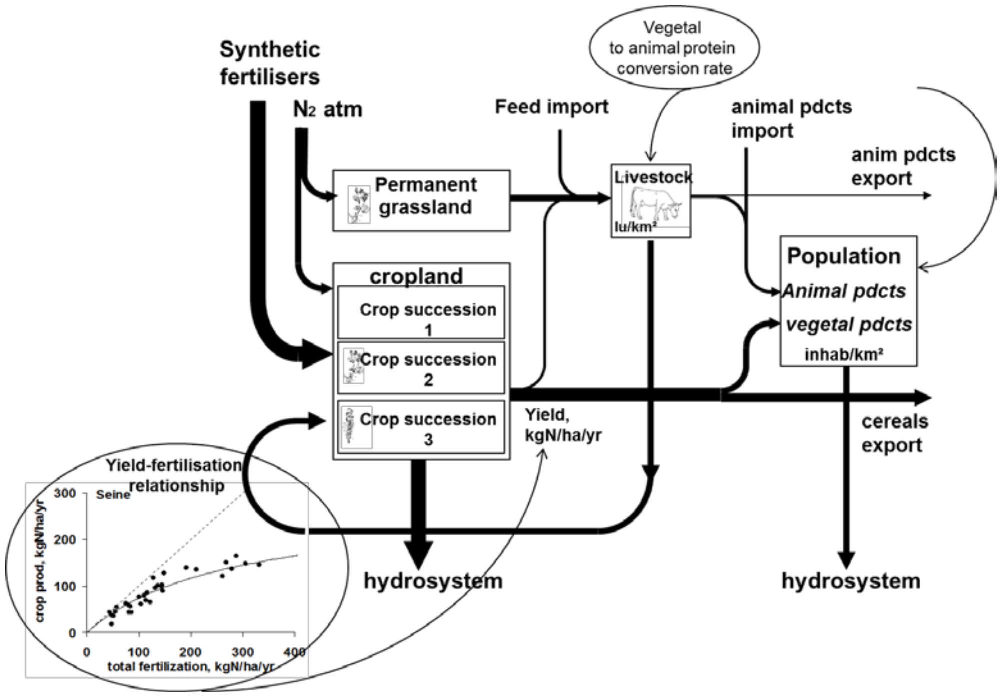


Figure A17.f5. *Conceptual approach of the agrofood system model (GRAFS)*

In order to apply the GRAFS approach to the case-study watersheds, a large set of data has been and will be gathered on land use, agriculture and livestock farming, and populations, including their historical variations, in order to reconstruct the trends. Once the losses to the environment have been quantified by the GRAFS approach, these results can feed the Riverstrahler model of biogeochemical functioning of land-to-sea continuum.

A major objective of the consortium will therefore to further develop existing models, newly taking into account organic cropping systems, allowing relating crop management techniques, yield, GHG and N emission/volatilization and NO_3^- leaching. The "ensemble" of models will be used as simulator for scenarios of a future sustainable agriculture that would not only prevent further damage to the environment, but would restore functions and services that have been lost.

One of the many exciting opportunities in this project is that we will have a generic conceptual tool applied to a variety of watersheds, providing the grounds for up-scaling from local experimental studies to the regional watershed scale, and further to the North European Atlantic façade.

The possible consideration of atmospheric nitrogen deposition and ozone effects in the model will be explored.

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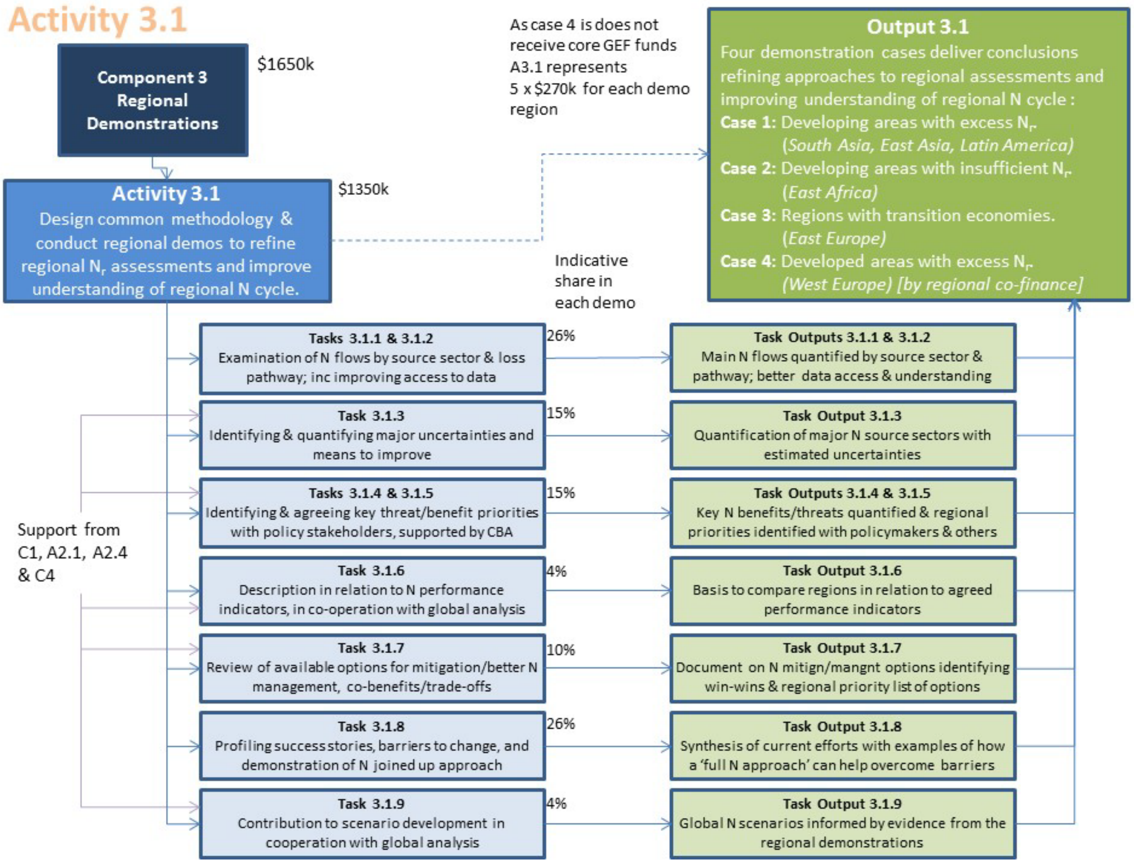
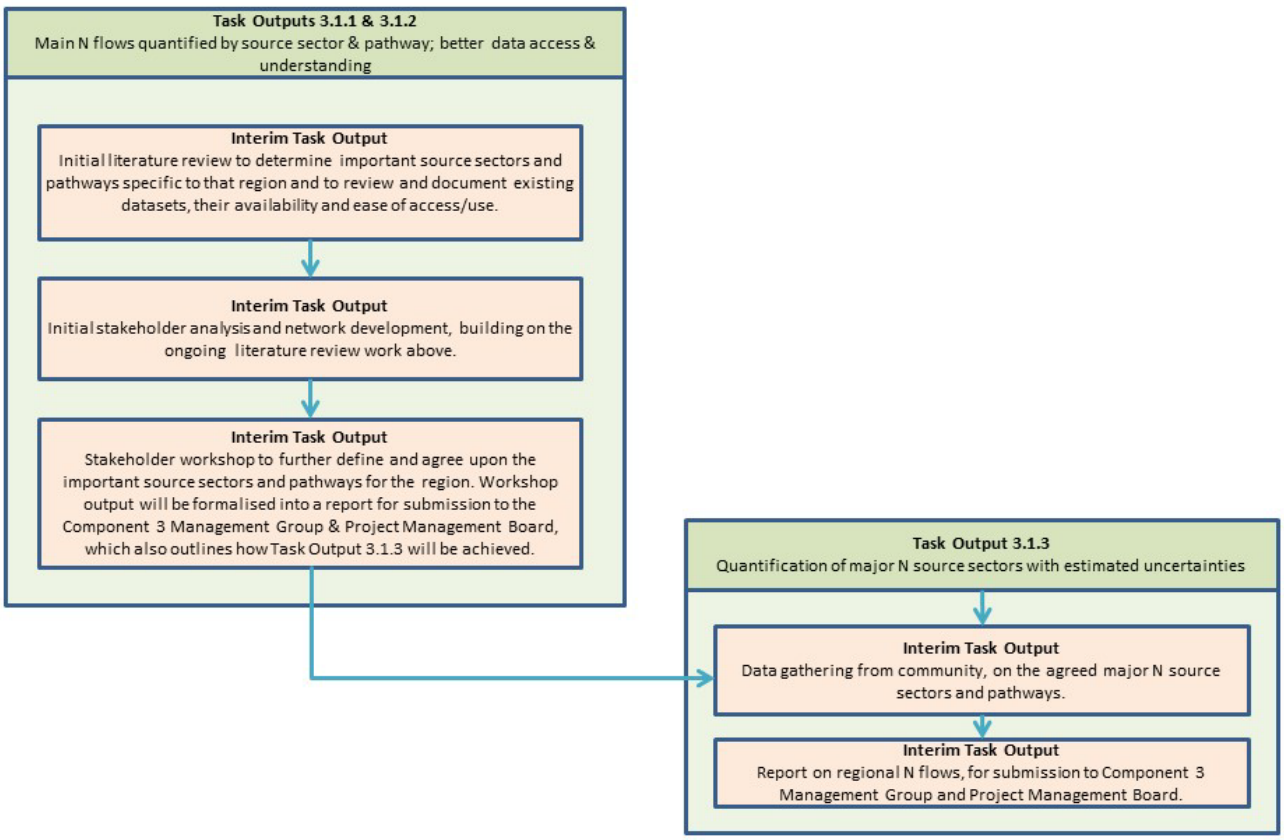
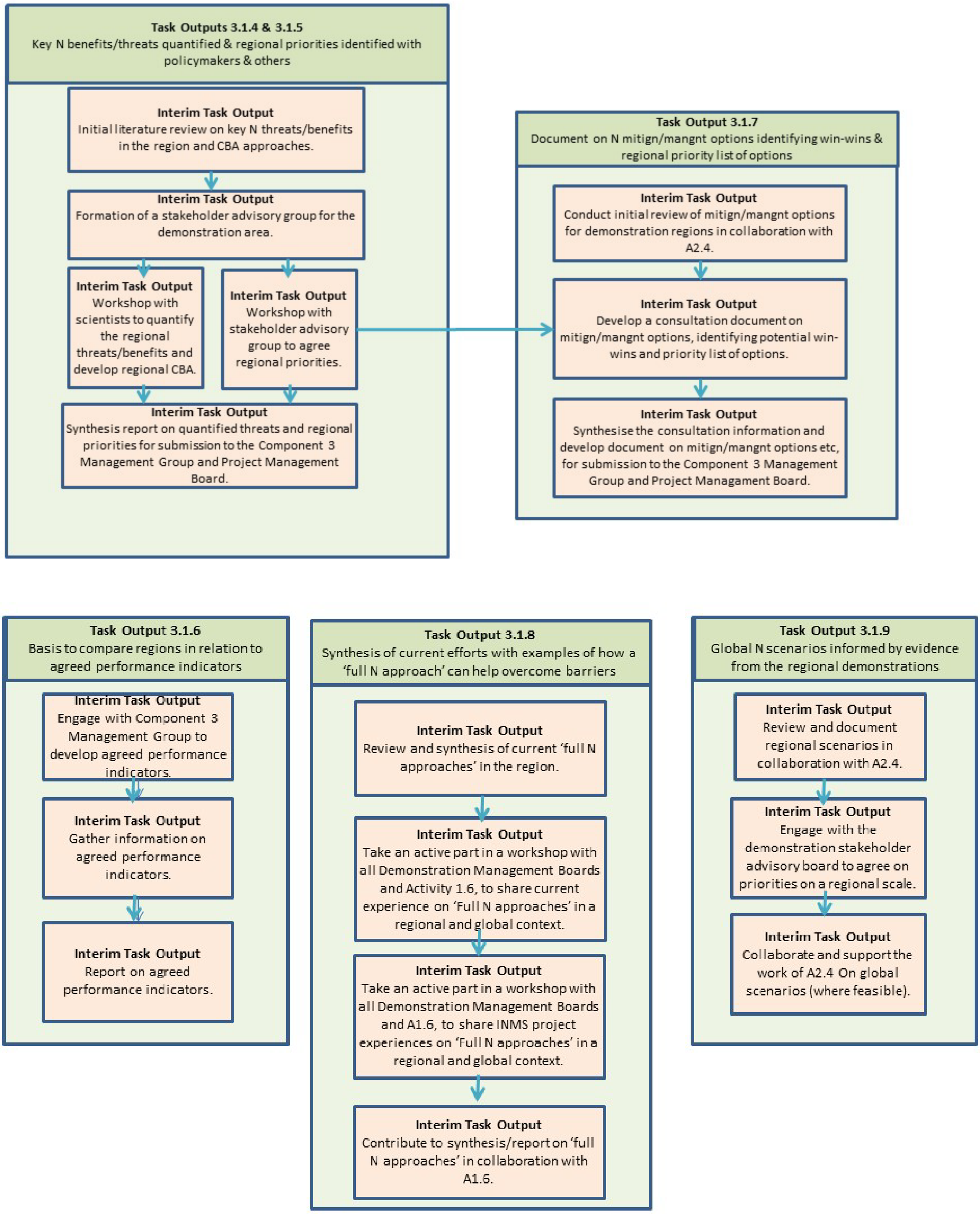

Activity 3.1
Component 3 Regional Demonstrations
$1650k
As case 4 is does not receive core GEF funds A3.1 represents 5 x $270k for each demo region
Output 3.1
Four demonstration cases deliver conclusions refining approaches to regional assessments and improving understanding of regional N cycle :
Case 1: Developing areas with excess N_r.
(South Asia, East Asia, Latin America)
Case 2: Developing areas with insufficient N_r.
(East Africa)
Case 3: Regions with transition economies.
(East Europe)
Case 4: Developed areas with excess N_r.
(West Europe) [by regional co-finance]
Activity 3.1
Design common methodology & conduct regional demos to refine regional N_r assessments and improve understanding of regional N cycle.
$1350k
Indicative share in each demo
Tasks 3.1.1 & 3.1.2
Examination of N flows by source sector & loss pathway; inc improving access to data
26%
Task Outputs 3.1.1 & 3.1.2
Main N flows quantified by source sector & pathway; better data access & understanding
Task 3.1.3
Identifying & quantifying major uncertainties and means to improve
15%
Task Output 3.1.3
Quantification of major N source sectors with estimated uncertainties
Tasks 3.1.4 & 3.1.5
Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA
15%
Task Outputs 3.1.4 & 3.1.5
Key N benefits/threats quantified & regional priorities identified with policymakers & others
Support from C1, A2.1, A2.4 & C4
Task 3.1.6
Description in relation to N performance indicators, in co-operation with global analysis
4%
Task Output 3.1.6
Basis to compare regions in relation to agreed performance indicators
Task 3.1.7
Review of available options for mitigation/better N management, co-benefits/trade-offs
10%
Task Output 3.1.7
Document on N mitign/mangnt options identifying win-wins & regional priority list of options
Task 3.1.8
Profiling success stories, barriers to change, and demonstration of N joined up approach
26%
Task Output 3.1.8
Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers
Task 3.1.9
Contribution to scenario development in cooperation with global analysis
4%
Task Output 3.1.9
Global N scenarios informed by evidence from the regional demonstrations


Task Outputs 3.1.1 & 3.1.2
Main N flows quantified by source sector & pathway; better data access & understanding
Interim Task Output
Initial literature review to determine important source sectors and pathways specific to that region and to review and document existing datasets, their availability and ease of access/use.
Interim Task Output
Initial stakeholder analysis and network development, building on the ongoing literature review work above.
Interim Task Output
Stakeholder workshop to further define and agree upon the important source sectors and pathways for the region. Workshop output will be formalised into a report for submission to the Component 3 Management Group & Project Management Board, which also outlines how Task Output 3.1.3 will be achieved.
Task Output 3.1.3
Quantification of major N source sectors with estimated uncertainties
Interim Task Output
Data gathering from community, on the agreed major N source sectors and pathways.
Interim Task Output
Report on regional N flows, for submission to Component 3 Management Group and Project Management Board.


Task Outputs 3.1.4 & 3.1.5
Key N benefits/threats quantified & regional priorities identified with policymakers & others
Interim Task Output
Initial literature review on key N threats/benefits in the region and CBA approaches.
Interim Task Output
Formation of a stakeholder advisory group for the demonstration area.
Interim Task Output
Workshop with scientists to quantify the regional threats/benefits and develop regional CBA.
Interim Task Output
Workshop with stakeholder advisory group to agree regional priorities.
Interim Task Output
Synthesis report on quantified threats and regional priorities for submission to the Component 3 Management Group and Project Management Board.
Task Output 3.1.7
Document on N mitign/mangnt options identifying win-wins & regional priority list of options
Interim Task Output
Conduct initial review of mitign/mangnt options for demonstration regions in collaboration with A2.4.
Interim Task Output
Develop a consultation document on mitign/mangnt options, identifying potential win-wins and priority list of options.
Interim Task Output
Synthesise the consultation information and develop document on mitign/mangnt options etc, for submission to the Component 3 Management Group and Project Managament Board.
Task Output 3.1.6
Basis to compare regions in relation to agreed performance indicators
Interim Task Output
Engage with Component 3 Management Group to develop agreed performance indicators.
Interim Task Output
Gather information on agreed performance indicators.
Interim Task Output
Report on agreed performance indicators.
Task Output 3.1.8
Synthesis of current efforts with examples of how a 'full N approach' can help overcome barriers
Interim Task Output
Review and synthesis of current 'full N approaches' in the region.
Interim Task Output
Take an active part in a workshop with all Demonstration Management Boards and Activity 1.6, to share current experience on 'Full N approaches' in a regional and global context.
Interim Task Output
Take an active part in a workshop with all Demonstration Management Boards and A1.6, to share INMS project experiences on 'Full N approaches' in a regional and global context.
Interim Task Output
Contribute to synthesis/report on 'full N approaches' in collaboration with A1.6.
Task Output 3.1.9
Global N scenarios informed by evidence from the regional demonstrations
Interim Task Output
Review and document regional scenarios in collaboration with A2.4.
Interim Task Output
Engage with the demonstration stakeholder advisory board to agree on priorities on a regional scale.
Interim Task Output
Collaborate and support the work of A2.4 On global scenarios (where feasible).

3.3 Budget and co-financing

3.3.1 Budget

As this demonstration is un-funded, this section is not applicable.

3.3.2 Co-financing

Co-financing comes essentially from the salary of involved participants and from equipment and field studies having been or currently supported by other projects (see § 2.1)

***Table A17f3:** Co-financing budget, listed by Task and Partner*

Task	Co-financing (USD)	Partner	Notes (including information on the project, links to the tasks, project duration etc.)
Task 3.1.1 & 3.1.2: Examination of N flows by source sector & loss pathway; inc improving access to data	341,300	UPMC, UPM, CIEMAT, INRA FFCUL	Field and laboratory experiments assessing the effect of farming practices (both conventional and organic) affecting N2O, NOx and NH3 emissions and NO3- leaching in temperate and Mediterranean agroecosystems. Examining the potential of those practices for behave as mitigation strategies. Process-based modelling of N losses in agroecosystems at both plot (Stics, DNDC models) and regional (i.e. Riverstrahler model for river basins) scales. Field measurement and modelling of N deposition in Mediterranean and temperate agroecosystems. The team has carried out studies under laboratory conditions addressed to evaluate the impact of soil conditions over the main pathways leading to consumption and production of pools of reactive N. Contribution on the basis of work performed by Citepa in France, and outputs of working groups with INRA, Ministries, Ademe and Agricultural Technical Institutes. Workshop for knowledge transfer regarding modeling nitrogen emission and deposition; identification of the most sensitive natural habitats (Natura 2000) to N deposition; modeling nitrate leaching to improve water quality; preliminary assessment of Portuguese N emission sources and mapping;
Task 3.1.3: Identifying & quantifying major uncertainties and means to improve	165,500	CIEMAT FFCUL INRA ISA	Collaboration with air quality modelers to validate modeled nitrogen deposition data and to identify major uncertainties in the modeling process. Develop parameterizations for modeling gas flux stomatal uptake adapted to Mediterranean vegetation. Thematic workshop to assess the current state of knowledge, the knowledge gaps, and the way forward to implement a national-scale assessment of the impacts of N deposition and atmospheric concentrations on biodiversity loss and biodiversity changes in the semi-natural habitats of Portugal; Contribution on the basis of previous collaboration between INRA, Ademe, Ministries, Agricultural Technical Institutes and agronomy universities. Contribution through the EU funded H2020 NitroPortugal Twinning project.
Task 3.1.4 & 3.1.5: Identifying & agreeing key threat/benefit priorities with policy stakeholders, supported by CBA	150,600	FFCUL INRA ADEME	Participatory workshop for knowledge transfer regarding modeling nitrogen emission and deposition; technical dissemination using participatory methods during stakeholder consultations; policy dissemination to inform policy makers of threats, benefits and solutions; Contribution on the basis of previous collaboration between INRA, Ademe, Ministries, Agricultural Technical Institutes and agronomy universities. Hosting workshop activities related to Case 4

Task 3.1.6: Description in relation to N performance indicators, in co-operation with global analysis	226,000	UPMC, UPM, INRA FFCUL	Analysis of the performance of agricultural practices at plot scale (e.g. NUE, yield-scaled N losses). Calculation of indicators in a regional basis (e.g. NUE, yield-scaled N gaseous emissions) for assessing the performance of NH3 and N2O abatement strategies in cropping systems. Development of national/global indicators (e.g. NUE) for the evaluation of scenarios based on structural changes (e.g. changes in diets and relocation of N in animal feed). Contribution on the basis of previous collaboration between INRA, Ademe, Ministries, Agricultural Technical Institutes and agronomy universities. Data from all available databases will be collated and organized to evaluate the current status of N regarding water, air and soil quality, greenhouse gas balance and impacts on ecosystem and biodiversity, and its indicators at ecosystem level;
Task 3.1.7: Review of available options for mitigation/better N management, co-benefits/trade-offs	181,100	UPMC, UPM, FFCUL INRA ADEME ISA	Regional-based scenario analysis for assessing the performance NO3 and NH3 and N2O abatement strategies in cropping systems in terms of improved NUE and decreasing yield-scaled N gaseous emissions. Strategies for managing nitrate water pollution and respective mitigation measures; overcoming barriers to minimize water pollution and maximizing the efficient use of water ; assessment of soil use related to traditional nitrogen fertilization in Portugal to assess potential N losses; synthesize the N issue holistically, for building the basis for the Portuguese Nitrogen Assessment Contribution on the basis of previous collaboration between INRA, Ademe, Ministries, Agricultural Technical Institutes and agronomy universities and outputs of collective scientific assessment performed by INRA. Hosting workshop activities related to Case 4 Contribution through the EU funded H2020 NitroPortugal Twinning project.
Task 3.1.8: Profiling success stories, barriers to change, and demonstration of N joined up approach	28,700	INRA ADEME	Contribution in the frame of French working groups meeting research, education and agriculture local partners. Hosting workshop activities related to Case 4
Task 3.1.9: Contribution to scenario development in cooperation with global analysis	96,000	UPMC, UPM, INRA, ISA	The Riverstrahler modelling approach newly developped in the framework of an ERANET project (EMOSEM), at the scale of all the watersheds of the EU-North Atlantic coast, from the Rhine to the Guadalquivir can be now used to explore scenarios, such as reduction of urban effluents, or good agriculture practices and even more radical scenarios with more deep changes in the agro-food systems, that could be co-constructed taking into account the situations in the INMS various case studies in the world.
Total co-financing	1,289,200		

3.4 Workplan

Activity 3.1	1º year				2º year				3º year				4º year			
Task 3.1.1 & Task 3.1.2																
Task 3.1.3																
Task 3.1.4 & Task 3.1.5																
Task 3.1.6																
Task 3.1.7																
Task 3.1.8																
Task 3.1.9																

3.5 Sustainability

The extent of sustainability will depend on the continuation of core institute programme funding which will be enhanced to the extent that external sources of funding can be obtained (e.g. by future EU funding sources)

3.6 Replication

This demonstration forms part of the replication of INMS by virtue of linking to the other regional demonstration activities.

3.7 Awareness raising, communications and dissemination

A WEB site will be created and used for publicizing the project and dissemination of the results. The WEB site will have information on project partners, project plan and timetable, upcoming events and obtained results. Farmers involved in the measurements will receive the data specific to their plots/rotations (soils characteristics, N leaching, N emission). Such a participative platform is currently working for several partners. During the project, a “policy brief” leaflet could be prepared and distributed to stakeholders, including public authorities, NGOs and farmers to keep them informed of the progress of WEST EUROPE Demonstration in ‘Towards INMS’. Besides communication with stakeholders, farmers and NGO and CSO’s, locally or nationally, discussions will be held at a European level to aid decision making on organic farming.

Results and the knowledge gained during the project will be disseminated within the scientific community through peer-reviewed papers. Also, the partners will be encouraged to present their results at national and international conferences and workshops, including those of the INMS project. Collaborative papers will be organized. Regarding education, new innovative courses at Universities will be developed, dealing with the new concepts of sustainable agriculture for protection of water quality together with GHG mitigation and food safety. The project should be finalized by an international workshop, gathering scientists and other stakeholders.

3.8 Execution arrangements

Western Europe Demonstration Management Group' (DMG – W Europe)

UPMC, Paris

The University of Pierre and Marie Curie (UPMC) is the largest in France. The METIS lab (UMR -7619) in association with the Center of National Research (CNRS) is focusing its activity on hydrogeophysical and biogeochemical modelling (head Prof. Jean-Marie Mouchel). The laboratory comprises several teams among which one group has developed an ecological modelling experimentally-based approach (Riverstrahler), taking explicitly the processes of microorganisms involved in the C, N, P, Si and oxygen cycles. The model links the water quality of river continuums from land-to-sea with human activities in the basin (water pollution by domestic effluents, agriculture contaminations). The nitrogen cascade and the nitrogen cycle in the water-agri-food have received major attention in the last 5 years, from local to global scales. Several studies have been recently conducted to analyse the performance of organic agriculture in terms of N losses in the environment (from NO_3^- lixiviation to aquifers to GHG –N_2O, NH_3- emission to the atmosphere. The group has been leading and/or participating to several large interdisciplinary programme at the national or European scales. The PIREN-Seine programme supported by the CNRS and water managers is lead by the group since 1989, an exemplarity for a long term interdisciplinary programme.

UPM, Madrid

The Spanish Team will be formed by 3 senior researchers, 2 assistant professors, 3 PhD student and 1 Technical Project Manager. They are all members of the research group COAPA (Environmental Pollution from Agricultural Practices) and AgSystems of the Technical University of Madrid (UPM) and have carried out extensive field experiments within the last 15 years aiming to assess the effect of crop management strategies. The experimental fields and infrastructure are situated in Central Spain (Tagus river basin, Autonomous Community of Madrid). Instruments at the field are frequency domain reflectometry (FDR) probes EnviroScan system for soil moisture, weather station, open static and dynamic chambers for NO_x measurements, closed chambers for N_2O, passive flux samplers for NH_3 measurements with micrometeorological methods (e.g. IHF method). Laboratory facilities at the Technical School of Agronomy (Technical University of Madrid, UPM): Gas Chromatography (for GHG quantification), Chemiluminescence equipment (NH_3), all the necessary durable equipment to analyze gas, soil and water samples (e.g. for NO_3^-, NH_4^+, DOC).

CIEMAT, Madrid

The research of the Spanish CIEMAT Team is focused on quantifying the interactive effects of ozone and nitrogenous compounds on Mediterranean vegetation and defining air pollutant threshold values (critical loads and levels) for the protection of ecosystems. The group has experience on atmospheric nitrogen deposition, particularly dry deposition. The group investigates the interactive effects of ozone and nitrogen enrichment on yield and quality of crops and the influence of climate change and air pollution on carbon and nitrogen cycles and soil-plant-atmosphere interactions in Mediterranean forests ecosystems and crops. This group has hold different agreements since 2001 with the Spanish Ministry of Environment with the objective to apply and adapt the methodologies developed under the framework of the Long Range Transboundary Air Pollution Convention

(CLRTAP) for establishing critical loads and levels for Mediterranean ecosystems. The CIEMAT research group is collaborating with the UPM team through several projects funded by regional, national and European agencies. The group manages an open-top chamber experimental field where to study the interactive effects of nitrogen and ozone. The experimental field is located in Central Spain, within the Tagus river basin. The group also manages a monitoring plot in the same area to characterize atmospheric nitrogen deposition.

FFCUL, Lisbon

The main goal of the Centre for Environmental Biology at FFCUL is to develop cutting-edge research to develop understanding of biological systems, from cells to landscapes, encompassing organism, population, community and ecosystem levels. Research at the centre covers both terrestrial and inland aquatic systems and a wide diversity of organisms, including bacteria, fungi, lichens, plants, invertebrates and all classes of vertebrates, as well as model organisms. The centre aims to bridge the gap between general patterns and their mechanistic basis, which is why an interdisciplinary research approach is used. This broad range of expertise is instrumental to our ultimate goals of developing efficient conservation programmes to preserve biodiversity and environmental quality, to define measures of sustainability and to understand the evolutionary and ecological dynamics of populations and communities. The goals of the centre also include research dissemination and training (at the levels of high-school, undergraduate, graduate and post-graduate education), the establishment of partnerships at both national and international levels with public and private entities, the communication of research both within and outside the scientific community, and the participation in services/activities for the society.

INRA, Grignon

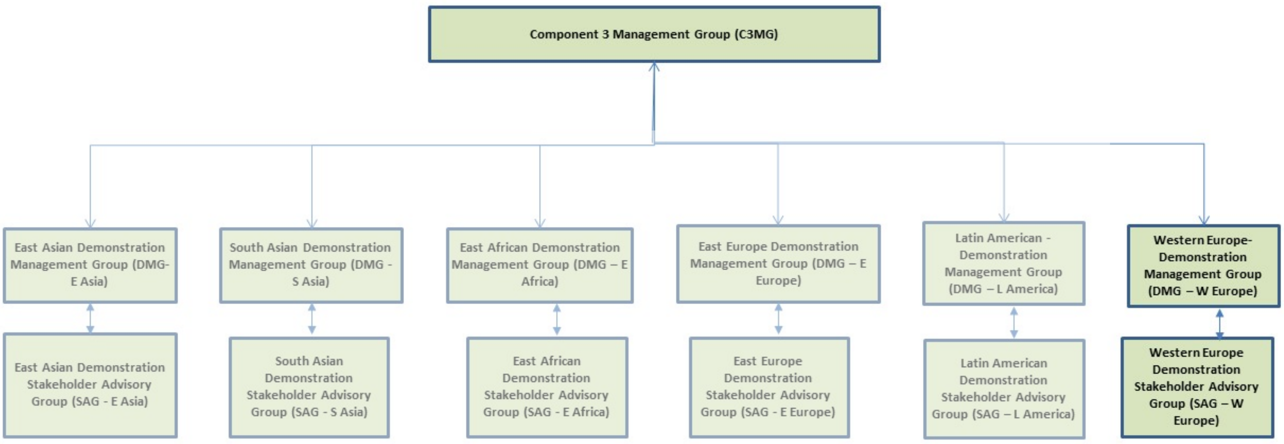
INRA is the biggest Institute for agronomic research in Europe. Reactive nitrogen is an issue which is mostly related to agriculture by the way of crop fertilisation and livestock farming (esp. manure management).The Environment and Agronomy (E&A) division (>40 labs, 750 permanent staff, more than 2000 including (i) permanent staff from other INRA divisions or universities associated to the labs, and (ii) contract staff (PhD students, post-doc, engineers and technicians)) conducts most of research on nitrogen in agroecosystems at INRA. E&A scientists thus have a range of skills on fertilization practices (not only N but also P; K and S), N cycle measurement and modelling, soil organic matter, organic manures management, long term observation, databases management and decision support tools development. Skills at INRA also include grassland and forests (EFPA division), economics (SAE2 division), social sciences (SAD division), plant breeding (BAP division), animal sciences (Phase division) and mathematics (MIA division).Thus INRA E&A could provide INMS with (i) databases on N use, on N, C and water fluxes, (ii) crop models including C and N cycling, economic models, actors models (iii) decision support tools for N fertilization and estimating N losses and (iv) long term observation sites. The E&A division also has strong partnerships with many agriculture stakeholders and French decision makers.

ADEME, France

In France, ADEME provides expertise and advisory services to businesses, local authorities and communities, government bodies and the public at large, to enable them to establish and consolidate their environmental action. As part of this work, the agency finances projects, from research to implementation, in its areas of action.

ISA, Lisbon

The Instituto Superior de Agronomia (ISA), School of Agriculture, is the largest and most qualified school of graduate and post-graduate degrees in the Agricultural Sciences, in Portugal, and its know-how is recognized nationally and internationally. With over 160 years of experience, it has been adjusting its teaching to both the technological evolution and the reality of the country, focusing both on quality and modernization.



4 Monitoring and Evaluation

4.1 Demonstration Project Results Framework

The Demonstration Project Results Framework is included below. All progress will be reported against this framework, to the extent practically possible in the absence of funding from GEF for this regional demonstration.

	Objectively Verifiable Indicators			Sources of Verification	Assumptions
Outcomes, Outputs and Activities	Indicator	Baseline	Target		
Outcome 4: GPA, OECD, UNEA and other bodies are better informed to assist states with implementing management response strategies to address negative effects of excess or insufficient N_r, ensuring that any negative effects are minimised	Project-level demonstration methodology guidelines adopted and published Requests for and application of demonstration area methodologies, tools and practice by external parties	Limited information from previous GEF interventions and partial N budget recently developed.	Project level methodology developed and agreed. Uptake of demonstration area methodology in other areas.	Workshop reports Contribution to synthesis documents	Active participation of the populations and policy makers in West Europe Availability of diversified expertise and technologies in West Europe supported by sufficient co-finance.
Output 3.1: A demonstration activity which delivers conclusions refining approaches to national / regional assessments and improving understanding of regional N cycle by addressing: Case 2: Challenges and opportunities for developing areas with insufficient reactive nitrogen. (Note that some aspects are also relevant to Case 1: Challenges and opportunities for developing areas with excess reactive nitrogen)	Report on N sources and N flows for Latin America. Report on consensus on N priority sources, forms and impacts for West Europe. Regional condition according to agreed N performance indicators. Information on priority N management and mitigation options. Information on successes and opportunities. Information on regional specificities for global scenarios	Lack of joined up data on N sources and flows regionally. Lack of knowledge on how N sources and impacts fit together. Lack of knowledge on how different N indicators relate, especially at regional level. Diversity of views and lack of consensus on the best methods to obtain N co-benefits. Variable progress, with limited attention to linking N co-benefits Existing global scenarios paying insufficient attention to regional conditions.	Quantified N flows, with uncertainty indication by end Year 3. Clearly identified priorities for N sources, forms and impacts by end Year 3 Statement of Latin American performance in using agreed N indicators by end Year 3. Draft 'Top 10' priority measures for improved N management for Latin America (end Year 2). Document for West Europe, showing how N approach can address barriers and share success stories (Year 4). Global scenarios informed by evidence from the West WEurop Demonstration (Year 3).	Reports, contrib'n to global synthesis (A2.2). Reports of science-stakeholder workshops. Report and contribution to INMS publications. Report provided to A2.3 for incorporation in global comparison. Documents for West Europe demonstration. Report from A2.4 workshop.	Sufficient co-finance.

4.2 M&E

In the absence of funding from GEF for this regional demonstration, the standard monitoring and evaluation procedures of the INMS Regional Demonstrations will be as followed as far as possible to the extent that independent resources allow.

Annex 1: Terms of Reference for Partners / Key Consultants

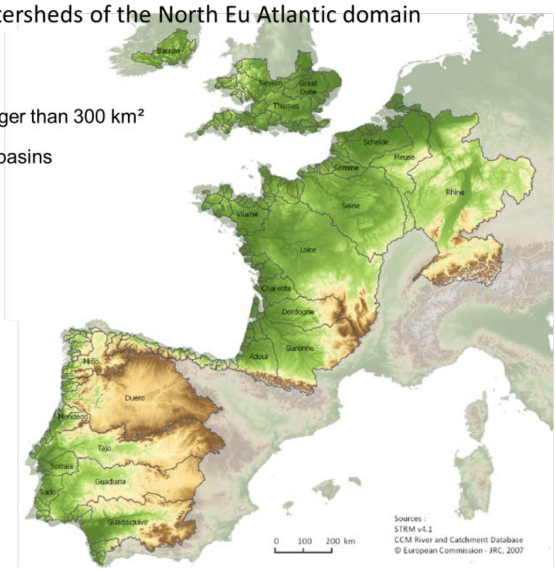
N/A

Annex 2: Details about Demonstration Region

Annex 2.1.

Terrestrial watersheds of the North Eu Atlantic domain

- 174 basins larger than 300 km²
- 17 main river basins



code	Name	Area (km²)	Strahler	Nb of objects
291110	Rhine	160 221.4	8	159
291111	Loire	116 981.0	8	110
442352	Duero	97 418.7	8	112
291115	Seine	75 989.5	7	77
442364	Tajo	71 202.1	7	51
442403	Guadiana	67 062.8	6	50
442365	Guadalquivir	57 052.5	7	46
291126	Garonne	55 703.1	7	67
291130	Meuse	32 047.2	6	26
291125	Dordogne	23 902.0	7	25
291133	Schelde	18 949.0	6	22
442355	Miño	16 985.1	7	25
291194	Adour	16 860.9	6	24
83811	Thames	13 513.7	5	6
291146	Vilaine	10 490.4	6	6
83749	Barrow	9 224.3	6	6
83751	Great Ouse	8 442.7	6	6

Annex 2.2.

Data bases gathered

Hydrological Data

Country	Producer
PT	SNIRH (Serviço Nacional de Informação de Recursos Hídricos) – INAG (Instituto da água)
ES	CEDEX (Centro de Estudios y Experimentacion de Obras Publicas)
FR	Banque Hydro
BE	Hydronet - Vlaamse Milieumaatschappij
	Aqualim - Région wallonne
	Voies hydrauliques - Région wallonne
NL	Waterbase - Ministry of infrastructure and the Environment
DE	GRDC (Global Runoff Data Centre)
CH	Federal Office for the Environment (FOEN)
UK	CEH (Centre for Ecology and Hydrology)
IE	Hydronet - Environmental Protection Agency (EPA)
	Office of Public Work (OPW)

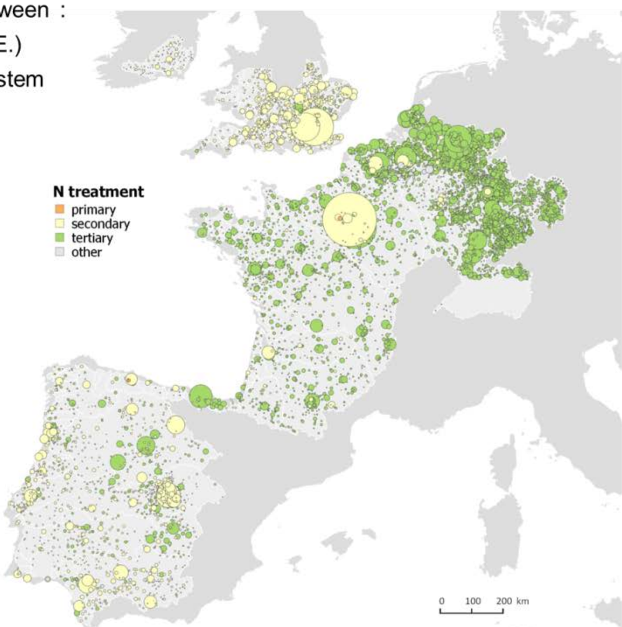
Water Quality Data

Country	Producer
PT	SNIRH (Serviço Nacional de Informação de Recursos Hídricos) – INAG (Instituto da água)
ES	Confederación Hidrográfica
FR	5 Water Agencies
BE	RHME
CH	Federal Office for the Environment (FOEN)
UK	Environment Agency
IE	Hydronet - Environmental Protection Agency (EPA)

Annex 2.3.

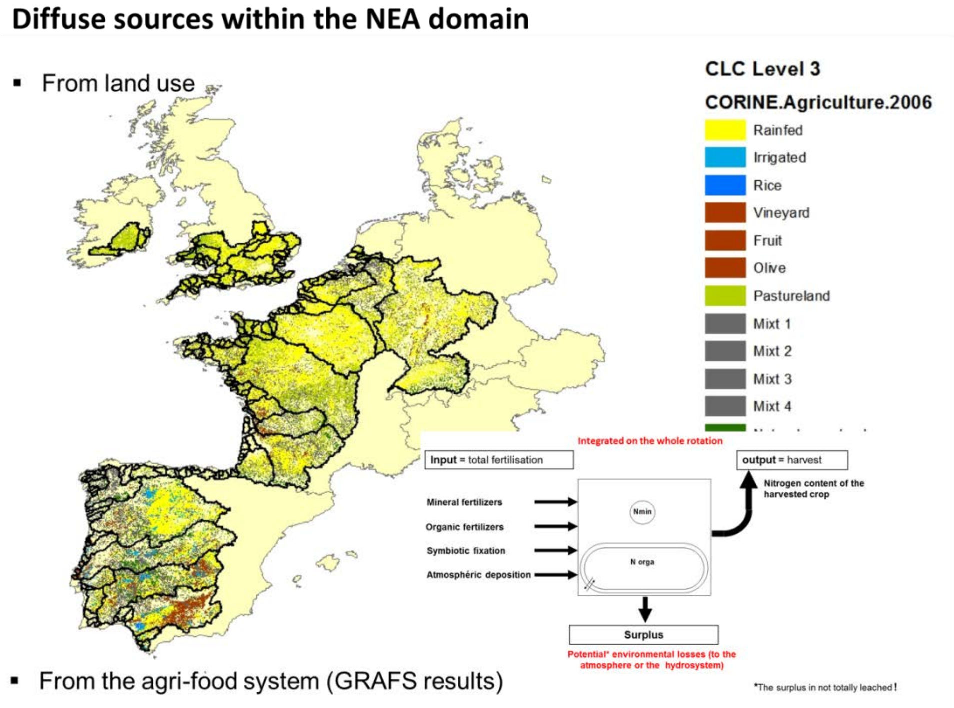
Point sources within the NEA domain

- Data source : Waterbase UWWTD EEA, 2012
- Complex database providing link between :
  - Agglomeration loads (> 2000 I.E.)
  - Rate of collection to sewage system
  - Connection(s) to WWTP
  - Treatment type (for N and P)
  - Sensitivity of “receiving area”



Sources :
CCM River and Catchment Database
© European Commission - JRC, 2007

Annex 2.4.


Diffuse sources within the NEA domain
From land use
CLC Level 3
CORINE.Agriculture.2006
Rainfed
Irrigated
Rice
Vineyard
Fruit
Olive
Pastureland
Mixt 1
Mixt 2
Mixt 3
Mixt 4
Integrated on the whole rotation
Input = total fertilisation
output = harvest
Nitrogen content of the harvested crop
Mineral fertilizers
Organic fertilizers
Symbiotic fixation
Atmosphéric deposition
Nmin
N orga
Surplus
Potential* environmental losses (to the atmosphere or the hydrosystem)
From the agri-food system (GRAFS results)
*The surplus in not totally leached !

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INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 18

Component 4: Awareness raising and knowledge sharing

Table of Contents

1 Component Identification

1.1 Component Summary

The purpose of this component is to support all internal and external communication and knowledge exchange in the project. Key to the success of this targeted research activity is the uptake of emerging results by other partners, ongoing engagement and exchange of ideas with stakeholders to ensure that tools and products are fit for purpose and communication of all results in the most effective way. As such, Component 4 will be informed by the key high-level outputs from the other three components and the needs and practicalities of partners and external stakeholders. A solid foundation will be built for internal communication within the project, e.g. newsletters, annual meetings and a dedicated members area of the web portal. Information and datasets within the project will be organised and made accessible through the web portal and INMS database system. This foundation will be paired with activities to engage with the N stakeholder community on a variety of levels, using a variety of approaches, including initiating a network of 'Nitrogen Champions'. Training will be provided to regional and national experts. The links between INMS, GPA and other relevant intergovernmental process will be made along with considering the long-term needs and implications of an INMS. Integrated guidance emerging from the project will be harmonised and communicated. Channels for knowledge exchange with the general public will also be explored and exploited, including further investigating N footprinting and developing audience relevant communication products for dissemination through the website.

The main elements are as follows:

1) Establishment of the INMS communications hub and its ongoing operation, including a web portal, the INMS database, internal project communication and press and public engagement functions;

2) Training in nitrogen measurement, modelling and mitigation techniques provided to regional and national experts, international engagement on linking intergovernmental processes and sharing experience on the use of N footprinting to increase public awareness;

3) Development of synthesis to demonstrate INMS in support of GPA objectives, co-ordinating the inputs from INMS and into other policy processes and formulating a long-term strategy for INMS, including potential homes and financing options;

4) Harmonization and publication of guidance documents on 'N budgets efficiency and benchmarking', 'threats fluxes and distribution methods', 'N measures and good practices' including information on barriers and successes;

5) Provision of support to IW-LEARN and engagement with GEF & STAP, including connecting the INMS web portal with IW-LEARN, developing a 'Community of Practice', 'Experience Notes' and taking part in IW-LEARN Conferences.

1.2 Links with other Components

This Component clearly links with all the other components of the project. All results from the project will need to be communicated internally and externally, using a variety of methods. Specific areas of focus will include supporting the links between the research occurring in the demonstration areas (A3.1) and other parts of the project. This is to ensure that relevant new methods, approaches and data can be passed to demonstration areas for their use (A3.1) and that the demonstration activities can inform the development of other activities, commenting on practical aspects, for example applicability in cases of 'too little' versus 'too much' N and regional socio-political differences. Central to the communications strategy is also an efficient mechanism for providing access to datasets and catalogued information. This will include information on N flows, threats and benefits at global and regional scales (A2.1) and textual information on methods, measures & good practices (T2.3.5). Such information will be gathered into an INMS database, which will be accessible to all partners through the INMS web portal. Component 4 will also be informed by the work on barriers to change (A1.6), applying this to the knowledge exchange methods used throughout the project, for example which audience to target, key messages to convey and form of approach. There is also a clear link between the development and delivery of a global assessment (A2.2) and more specifically distillation and dissemination of key messages arising from it and delivery of a high profile launch (T2.2.5). In parallel to this, support for harmonisation and dissemination of the three key guidance documents (A1.1, A1.2, A1.3) will also be provided. Training of regional and national experts is planned, including diffusion of new technologies and implementation of indicators (A1.1).

2 Component Design

2.1 Background and context

Components 1-3 (C1-C3) of the INMS project are designed to develop the scientific basis that can be used to support international policy development across the nitrogen cycle. Component 4 will assist with the uptake of the emerging messages from C1-C3 and support delivery of approaches which are fit for purpose. The focus of this awareness raising will be on the wide range of stakeholders using N_r and guidance and other assistance will be specifically targeted at relevant stakeholder groups. This Component will therefore be a key point of contact between the project and the developing intergovernmental policy arena including GPA, CBD, FAO, OECD, UNECE, EU, together with business and civil society groups to assist in strengthening the science- policy links on reactive nitrogen within the environment. Engagement will be needed from national through to global processes and across all environmental compartments and issues, such as water, air, climate, ecosystems and soils.

There will also be a focus on strengthening public engagement, which will feedback to the policy domain, by increasing support for the need for policy and improving implementation. Emerging research on barriers to change will be utilised in the development of engagement strategies. Engagement across the stakeholder network will be undertaken using a variety of tools, including the development of a web portal and multi-media resources. These resources will be developed for use across the broad stakeholder base of the project, from intergovernmental policy to the public. They will be designed not only for direct engagement, but also as ready-to-use materials for cascade training and engagement to others, such as advisers, the press or in education. To maximise the effectiveness of the tools and documents emerging, harmonising activities will be undertaken, to finesse key messages and supporting resources. Similarly, partners in the project will be utilised as vehicles to engage with their networks, countries and intergovernmental processes. Component 4 will also support the development of the INMS database, which will be central not only to information sharing within the project, but also demonstration of the messages emerging.

Key outputs of Component 4 are:

Output 4.1 Information sharing and networking portal to assist the GPA, OECD, UNEA, UNECE and other bodies with uptake of understanding of N cycle and means to mitigate negative impacts.

Output 4.2 Training for regional/national experts to sustain and enhance understanding of global N cycle implementation of national indicators, diffusion of new technologies and links across the nitrogen policy arena relevant for inter-governmental processes.

Output 4.3. Overall demonstration of the International Nitrogen Management System (INMS) in support of understanding the Global Nitrogen Cycle to further strengthen the objectives of GPA, UNEA, OECD, UNECE and other bodies across the emerging Policy Arena on Nitrogen.

Output 4.4. Presentation of INMS development to UN Environment Assembly in Yrs 1 & 3

Output 4.5. Guidance documents specific to selected stakeholders advising on assessing and presenting nitrogen management and use efficiency issues

Output 4.6. With 1% of the project resources in support of IW:LEARN

Output 4.7. Dedicated project website connected with IW:LEARN and other GEF knowledge management systems (within 6 months).

Output 4.8. Documented cooperation and knowledge exchange with (i) IW:LEARN including at least one functioning CoP as well as (ii) with STAP.

Output 4.9. Participation at the International Waters conferences; at least 3 experiences notes and tracked project progress reported using the GEF5 IW tracking tool.

2.2 Baseline

2.2.1 Baseline analysis

INMS Web Portal & Communications Hub

The INMS web portal and communications hub will be developed specifically for the project. The PCU has substantial expertise in delivering and managing websites for projects. This expertise will be used to deliver a custom built web portal, with dedicated areas for INMS project members, the press etc. The project will also draw on the strengths of other web portals in International Waters and on nutrient management topics, such as the 'The Nutrient Challenge' website hosted by the GPNM and the website of the 'International Nitrogen Initiative'.

INMS Database

A new database to support the data flow within the INMS project will be needed. However, within the PCU there is significant experience in the delivery of database systems, from the storage of time series data for measurement and modelling projects (EU-FP6 NitroEurope IP, EU-FP7 ECLAIRE) through to cataloguing and toolbox approaches (LIASE TOOLBOX and APIS). The project will also draw on expertise from other cataloguing and databasing activities in this area, such as the Tool Box Approach in the

GEF/UNEP Global Nutrient Cycles project (in this case cataloguing different kinds of good practices for better nutrient management).

Nitrogen Footprinting

The use of N foot-printing as a means of developing public awareness will be explored in the INMS project. The N-Calculator tool, hosted at the N-print website[1] allows the public to calculate their own personal N-footprint, using information on their food consumption, housing, transportation and goods and services[2]. The N-Calculator is currently available online for the United States, Netherlands, Germany, and United Kingdom. Versions for Austria, Japan, Australia, China, Denmark and Tanzania are in various stages of development.

2.3 Overall objective and outcome

2.4 Activities and Outputs

Overall Component Co-Leads: PCU (Howard, CEH) and Global INI (Bleeker, PBL).

2.4.1 Activity 4.1: Establishment and operation of INMS communications hub

Output 4.1: Information sharing and networking portal to assist the GPA, OECD, UNEA, UNECE and other bodies with uptake of understanding of Nr cycle and means to mitigate negative impacts.

Activity Co-leads: Global INI (Bleeker, PBL) and PCU (Howard, CEH).

The elements of this activity are summarized visually in Figure A18.1. They form the core of the communications function and strategy of the project. The project contains a diverse set of partners, from research organisations to business and industry and similarly needs to engage with a diverse set of stakeholders, from intergovernmental processes to the public. This Activity therefore brings together a range of approaches to engaging with the wide range of communities involved. Task 4.1.1 will focus on the establishment, population and operation of the INMS web portal, which will be the first port of call for all partners and stakeholders. A high quality web presence will be designed and implemented, including a members' only area. This will allow the portal to both support the ongoing work of the project and provide a platform for stakeholder exchange and dissemination of results and key messages emerging from the project, which links also to Task 4.1.4. The portal will be flexible enough to allow groups to discuss their work in dedicated forums and link to social media. Accessed through the portal, the focus of task 4.1.2 will be the establishment of an INMS database system. A wide range of potential datasets and catalogued information will need to be accessible to partners. The necessary datasets will need to be identified and the most suitable way of providing access to them, be designed and delivered. Internal communication will be the focus of Task 4.1.3, which in connection with the work of Task 4.1.1 on the web portal, will establish and maintain information exchange with the partners, e.g. through newsletters, provision of background documents to INMS plenary meetings and circulating items for consultation. In Task 4.1.4 the effort will be focussed on widening the stakeholder engagement of the project, including

[1] http://www.n-print.org/

[2] Leach, AM, JN Galloway, A Bleeker, JW Erisman, R Kohn, J Kitzes. 2012. A nitrogen footprint model to help consumers understand their role in nitrogen losses to the environment. Environmental Development 1: 40-66.

through the development of key messages for use in the media and for the public. Engagement products, paper based but also potentially video or audio products, along with working with the press to raise the profile of documents emerging from the project will be required. Again this will link closely with the work of Task 4.1.1, as all products developed will be made accessible on the web portal.

INMS partners proposing to contribute to this Activity include: IITA (Africa), AU Agro (Denmark), ECN (The Netherlands), WRI (US), UED (UK).

The following have expressed interest to advise and review the work: INRA (France).

Each of the four **Tasks** is associated with a specific **Task Output.**

2.4.1.1 Task 4.1.1: Establishment, population & operation of INMS web portal

Task Output 4.1.1: INMS web portal operational with active information exchange

Task Co-leads: INI (Bleeker, PCU, PBL) and INI (Howard, PCU, NERC).

The main focus of this activity is in support of the INMS web portal. The web portal will be the first port of call for all partners and external stakeholders and therefore must be of high quality and high impact. A system which is both user friendly for internal updating and for partners to interact with (e.g. fora, posting events etc) is required. After establishment of the system, a period of initial web portal population will be required, developing a structure which is easy to use but flexible to the needs of a four year project. This will include the provision of a members only area to allow secure exchange of information within the partners, where required. As well as providing the technical function to deliver the web portal, there will be a need to engage with project partners and stakeholders to allow delivery of up-to-date content, to make the web portal relevant for users. This work links closely then with Task 4.1.3, which covers internal communication within the project. Similarly, the web portal design will need to consider the needs of the INMS database (Task 4.1.2), which will be accessed through the portal. Due to the provision of data and potential access to personal information such as partner contact details, the relevant data protection laws will also be considered.

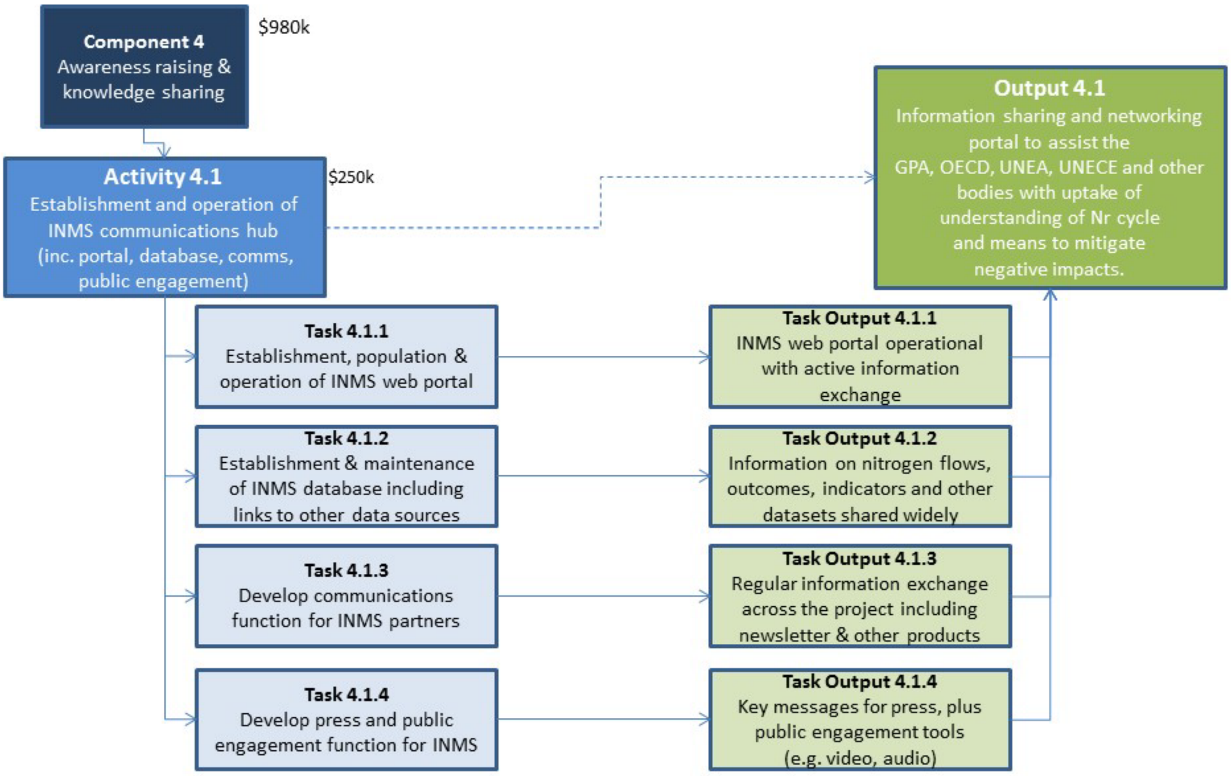

Figure A18.1: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation to establishing and operating the INMS communications hub (Activity 4.1; Output 4.1).*

2.4.1.2 Task 4.1.2: Establishment & maintenance of INMS database including links to other data sources

Task Output 4.1.2: Information on nitrogen flows, outcomes, indicators and other datasets shared widely

Task Co-Leads: INI (Bealey and Howard, PCU, NERC).

This Task has clear links with both the development of a shared database of inputs and model outcomes (A2.1) and the practices database (T2.3.5). Whilst the aforementioned tasks will focus on identifying, gathering and categorising the necessary material, this Task will provide the technical support to design, implement and maintain the data storage where necessary, and its access through the INMS web portal (T4.1.1). Issues of data protection and accountability will be addressed as required.

It is anticipated that following the creation of a data sources profile (A2.1) for the project, some datasets will emerge as being already stored elsewhere, in which case this Task will provide the expertise and support to link this data to the web portal, potentially utilising the ENCORE data cluster system established by NERC under the ÉCLAIRE project. Once the database and the linked data system has been established, user friendly guidance documents will be established and disseminated, through the web portal.

2.4.1.3 Task 4.1.3: Develop communications function for INMS partners

Task Output: 4.1.3: Regular information exchange across the project including newsletter & other products

Task Co-Leads: INI (Howard, PCU, NERC) and INI (Bleeker, PCU, PBL).

In Task 4.1.3 the focus will be to provide all necessary communications with partners in the project. This Task is essential to support the information flow to deliver the outcomes of the targeted research and reporting requirements. Information exchange will be provided through both e-mail contact and the web portal (T4.1.1). A regular newsletter, including updates on the project and upcoming workshops will be circulated to partners. All partners will also be encouraged to contribute to the newsletter, increasing awareness across the project on the range of stakeholders involved and their expertise. The web portal will allow partners to communicate across the project, through dedicated sections for stakeholder groups and components and including the provision of online fora, when relevant. The PCU will also use the web portal to engage in consultation exercises.

The annual INMS plenary meetings will form a key part of the communications strategy for the project. At this time the Project Partners Assembly (consisting of representatives of each partner) will receive an update on the progress over the previous 12 months and be provided the opportunity to endorse emerging reports and products along with the future workplan.

2.4.1.4 Task 4.1.4: Develop press and public engagement function for INMS

Output 4.1.4: Key messages for press, plus public engagement tools (e.g. video, audio)

Task Co-Leads: INI (Howard and Sutton, PCU, NERC).

The purpose of this Task is to support all press and public engagement activity within the project. From the start of the project press relevant content will be developed and added to the website in collaboration with Task 4.1.1. Content will include clear background information on the nitrogen issue, links to high profile N related documents and key messages from a regional and global context, including access to copyright free images and graphics which could be used in news stories. Content will continue to be updated throughout the project as further publications and messages emerge. As the project progresses press strategies for key reports and messages will be developed, each one building on and linking to the previous one. This ongoing and increasing activity is aimed at improving the general awareness and interest from the press and public in the N issue and will culminate in the launch of the Global Assessment and the final results of the INMS project. Throughout the project, the press activity will also be informed by the emerging work on barriers to change (A1.6) allowing messages and strategies to be tailored in the most effective way. The project will also benefit from the knowledge and contacts gained from other partners in dealing with the press and launching N related publications in recent years. Key relationships with members of the press will be maintained and a list of press contacts developed and utilised.

Public engagement will go hand in hand with the press activity and again be informed throughout the project, by emerging information on barriers to change (A1.6). A number of successful N engagement products have been developed and this Task will identify such products and showcase them on the INMS web portal. This also links with the sharing of experiences on the N Footprint Calculator (T4.2.3). Further public engagement tools such as infographics, audio and video content will be developed as informed by the identified barriers to change and the messages emerging from the project. As with the press engagement strategy, this activity will build during the project, leading up to the launch of the Global Assessment and findings of the project, which will be translated into key messages and products relevant for the public. The web portal will act as a hub for the public engagement strategy and visitors will be encouraged to join the mailing list for updates. Social media will be used to highlight key reports, meetings and messages and draw further attention to the press activity.

To enhance the knowledge exchange within the INMS project, a network of Nitrogen Champions will also be developed. These individuals will have increased awareness of the N issue and access to updates and resources which means that they are primed to be able to communicate the N issue and best management practices, with relevance to their field at the time it is needed. At the national and intergovernmental level, this activity links with training of experts and engaging with intergovernmental networks (T 4.2.1 & T4.2.2). Other relevant groups are for example civil society and NGO's, education, the public and press. This list will also include farming, industry and business, for example in the food chain production and retailing sector. Nitrogen Champions would also be invited to advise and review the relevance of engagement messages and materials before wide release, ensuring they are fit for purpose.[3]

2.4.2 Activity 4.2: INMS training, diffusion and international relations, including nitrogen footprinting

Output 4.2: Training for regional/national experts to sustain and enhance understanding of global N cycle implementation of national indicators, diffusion of new technologies links across the nitrogen policy arena relevant for inter-governmental processes.

Activity Co-leads: INI (Bleeker, PBL) and INI (Howard, PCU, NERC).

The elements of this activity are summarized in Figure A18.2. Task 4.2.1 will enable the uptake of the results of the targeted research in the project on measurement, modelling and mitigation techniques. Both formal and informal training options will be explored for delivery and the most suitable method agreed upon during the project. This Task also provides an opportunity to link and showcase other existing training for regional and national experts, along with training for other groups, e.g. extension services and engaging with the public. There are then natural links to the work on the INMS communications hub (A4.1) and the development of 'Nitrogen Champions' (T4.1.4) at the national and regional level. The Task will also be informed by the work on indicators (A1.1) as well as other arising relevant parts of the project.

Task 4.2.2 focusses on increasing international engagement between the project and countries, specifically on the links between GPA and intergovernmental processes. Links will be made with the developing work on a 'policy arena for nitrogen', including synthesis of key messages and engagement with both GPA and other policy processes (A4.3-4.4). As with T4.2.1, this Task also links clearly with the development of 'Nitrogen Champions' (T4.1.4). A network of relevant contacts within GPA and other policy processes will be developed and primed with relevant information. Key 'policy intervention points' such as meetings, side-events etc will be identified as key opportunities to engage on the aims and relevance of an INMS process and the findings of the 'Towards INMS' project.

[3] Note that the term 'Nitrogen Champions' is an umbrella term for use within the project for persons who are engaged on the Nitrogen topic and for which specific materials will be developed for use in their relative fields. For the purposes of reporting lists will be supplied of persons who we gauge to have been trained or are acting in the capacity of a 'Nitrogen Champion', however it is not currently intended that these lists be public, or that the term 'Nitrogen Champions' be used for branding purposes.

The purpose of Task 4.2.3 is to share experience on N-Footprinting, which has been facilitated by the N-Calculator tool, developed in collaboration with the North American Centre of INI. The current usage and future potential of the N-Calculator will be addressed and this Task has clear links to the wider public engagement strategy for the project (T4.1.4).

INMS partners proposing to contribute to this activity include: US EPA (USA), IITA (Africa), UED (UK), BRRI (Bangladesh), LVBC (Uganda), ECN (The Netherlands).

The following have expressed interest to advise and review the work: INRA (France).

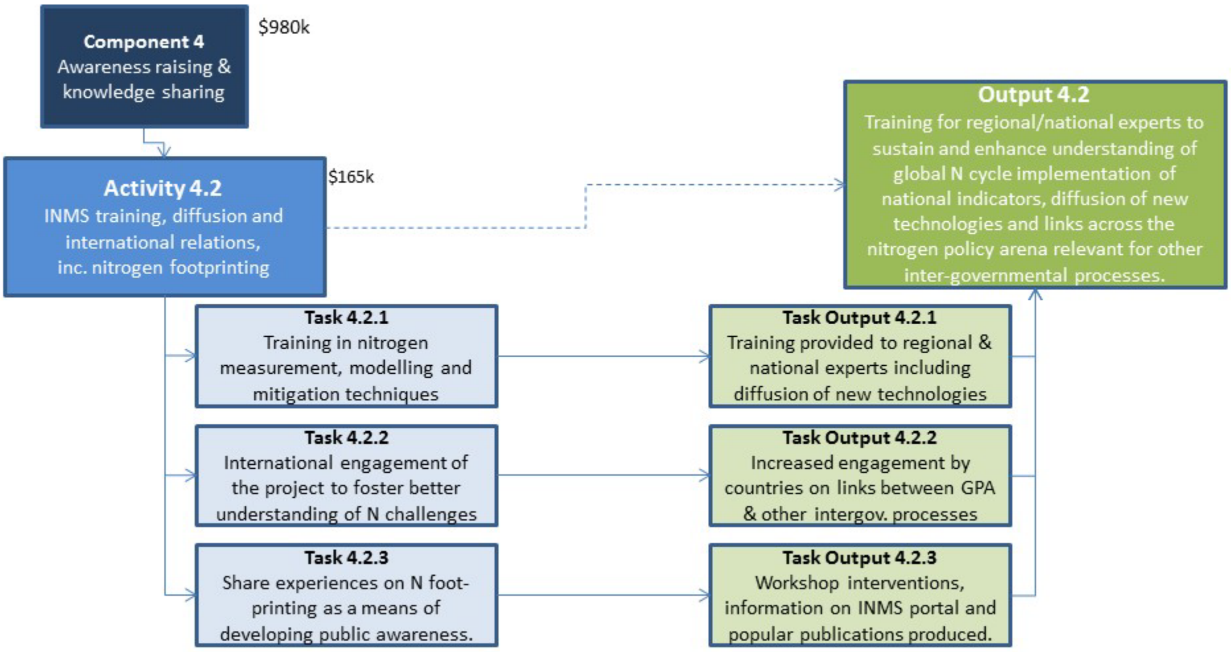

Figure A18.2: *Summary of Tasks and Task Outputs needed to reach the overall Output in relation to providing training, diffusion and international relations, including nitrogen footprinting. (Activity 4.2; Output 4.2).*

2.4.2.1 Task 4.2.1: Training in nitrogen measurement, modelling and mitigation techniques

Task Output 4.2.1: Training provided to regional & national experts including diffusion of new technologies

Task Co-Leads: INI (Bleeker, PBL) and INI (Howard, PCU, NERC).

Training materials to support regional and national experts in nitrogen measurement, modelling and mitigation techniques, as informed by the results of the project, will be developed and added to the INMS web portal. This will include the development of a ‘Massive Online Open learning Course’ (MOOC), in collaboration with the NEWS-India project and University of Edinburgh. Other modes of training will also be explored and utilised, depending on resource and co-financing abilities throughout the project. Work on this Task will occur in concert with the development of Nitrogen Champions in this sector (T4.1.4). The project will also utilise existing training materials, using the web portal as a means to showcase good training and publicise events being organised through other networks. During both the development of the Nitrogen Champions Network, INMS plenary and other meetings, at least one face-to-face development and training workshop will be organised.

INMS partners proposing to contribute to this activity include: PCH, (Spain), BRRI (Bangladesh), FAO (International), AUBios (Denmark), ASU (Lithuania), ECN (the Netherlands), UED (UK), LVBC (Uganda).

The following have expressed interest to advise and review the work: INRA (France).

2.4.2.2 Task 4.2.2: International engagement of the project to foster better understanding of N challenges

Task Output 4.2.2: Increased engagement by countries on links between GPA & other intergovernmental processes

Task Co-Leads: OECD (Bonnis) & INI (Sutton, NERC)

This Task will focus on engagement at country representative level and above on the links between GPA and other intergovernmental processes. Development of the INMS network will be achieved through representation of the project at high-level fora, such as GPA, OECD, UNECE, CBD, UNFCCC as necessary. To ensure consistency and effectiveness, the task will be informed by emerging messages and target organisations regarding the development of a ‘policy arena for nitrogen’ and its links to GPA and existing intergovernmental processes (A4.3-4.4). Engagement will occur both through existing INMS partners and the ‘Nitrogen Champions’ network (T4.1.4).

INMS partners proposing to contribute to this activity include: NERC, OECD, UNEP, IPU, IITA (Africa), FAO, VU, ECN (the Netherlands), UED (UK), LVBC (Uganda), SEI (York).

The following have expressed interest to advise and review the work: INRA (France).

2.4.2.3 Task 4.2.3 Share experiences on N foot-printing as a means of developing public awareness.

Task Output 4.2.3: Workshop interventions, information on INMS portal and popular publications produced.

Task Co-Leads: INI (Bleeker, PBL) and INI N America (Galloway).

This Task provides an opportunity to share experiences on the use of N-footprinting as a means of developing public awareness (for example making the public aware of how their lifestyle choices may contribute to the release of nitrogen into the environment). The N-Calculator tool, hosted at the N-print website[4] allows the public to calculate their own personal N-footprint, using information on their food consumption, housing, transportation and goods and services[5]. The N-Calculator is currently available online for the United States, Netherlands, Germany, and United Kingdom. Versions for Austria, Japan, Australia, China, Denmark and Tanzania are in various stages of development. A workshop will be hosted to share experiences on the development and use of the N-Calculator tool, including potential rollout to other countries. There are clear potential links to public engagement (T4.1.4) and work in the demonstration areas (A3.1). Existing tools are available in three countries associated with regional demonstrations, covering both those with ‘too much’ N and those with ‘too little’ N. Resources to promote both existing and future country specific tools will be developed and provided on the INMS web portal.

INMS partners proposing to contribute to this activity include: North American Centre of INI, VU, ECN (the Netherlands).

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[4] http://www.n-print.org/

[5] Leach, AM, JN Galloway, A Bleeker, JW Erisman, R Kohn, J Kitzes. 2012. A nitrogen footprint model to help consumers understand their role in nitrogen losses to the environment. Environmental Development 1: 40-66.

2.4.3 Activity 4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & development of long-term strategy

Output 4.3: Overall demonstration of the International Nitrogen Management System (INMS) in support of understanding the Global Nitrogen Cycle to further strengthen the objectives of GPA, UNEA, OECD, UNECE and other bodies across the emerging Policy Arena on Nitrogen.

Output 4.4: Presentation of INMS development to UN Environment Assembly

Activity Co-Leads: INI (Sutton, PCU, NERC) & GPA (Cox).

The elements of these activities are summarized visually in Figure A18.3. The activities focus on delivering high level relevant messages emerging from INMS, in regional through to intergovernmental settings. Thus strengthening the understanding of the Global N Cycle with respect to GPA objectives and in regional to global policy settings. Throughout the project, the targeted research will be translated into key messages, which are audience relevant (T4.3.1). This message development and refinement will take place in consultation with the Project Management Board and stakeholder groups. In order to maximise the effective uptake of the key messages from INMS, in regional to intergovernmental settings, an engagement strategy will be developed (T4.4.1). The strategy will consider the timescale and needs of each process and potential opportunities in terms of individuals and key meetings involved. Finally, the future sustainability of INMS will be examined, including potential homes and financing mechanisms (T4.4.2). This will link closely with the ongoing engagement on INMS in regional and intergovernmental settings (T4.4.1).

[*No organisation selected to lead this Activity and information was not requested at a task level. Therefore below are ALL contributing offers.]*

INMS partners proposing to contribute to this activity include: NERC, UNEP, IITA (Africa), UNECE, US EPA (USA), RIVM (Netherlands), ECN (the Netherlands).

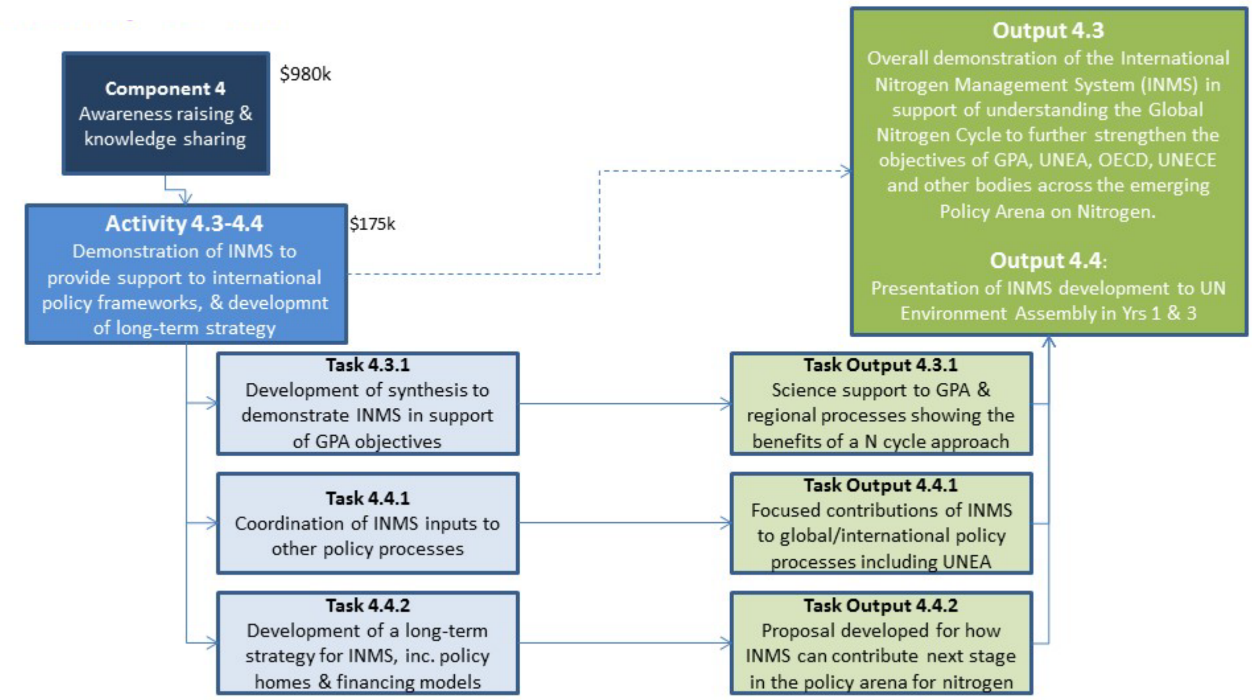

Figure A18.3: *Summary of Tasks and Task Outputs needed to reach the overall Outputs in relation to providing training, diffusion and international relations, including nitrogen footprinting. (Activities 4.3 & 4.4; Outputs 4.3 & 4.4).*

2.4.3.1 Task 4.3.1 Development of synthesis to demonstrate INMS in support of GPA objectives

Task Output 4.3.1: Science support to GPA & regional processes showing the benefits of a N cycle approach

Task Co-Leads: GPA (Cox) & INI (Sutton, PCU, NERC).

Drawing on the results of the targeted research, this Task will synthesise key messages which demonstrate the benefits of a Nitrogen cycle approach for relevant audiences. This will include information of relevance to both GPA and regional processes, such as the UNECE, SACEP, regional seas commissions and conventions etc. Key messages will be developed in close communication with the Project Management Board and stakeholder groups within the project. Increased activity will occur as the project draws to a close and final findings are released, along with the Global Assessment Report (A2.2). This Task will ensure continuity and consistency in the communications arising from the project.

In parallel to this, 'policy intervention points' and related key individuals within GPA and regional processes will be identified and engaged with, to inform their networks about INMS, using the key messages identified. In this way the work will link closely with the development of 'Nitrogen Champions' (4.1.4). The work will happen in collaboration with Task 4.4.1, which will co-ordinate INMS inputs to other policy processes, ensuring the most effective approach in reaching out to the wider stakeholder network. Clear links also exist to the development of a 'Policy Arena for Nitrogen' (T4.4.2).

INMS partners proposing to contribute to this activity include: NERC (UK), UNEP, IITA (Africa), VU, ECN (the Netherlands).

The following have expressed interest to advise and review the work: INRA (France).

2.4.3.2 Task 4.4.1 Coordination of INMS inputs to other policy processes

Task Output 4.4.1: Focused contributions of INMS to global/international policy processes including UNEA

Task Co-Leads: INI (Howard and Sutton, PCU, NERC).

The focus of this Task is ensuring a co-ordinated approach to the engagement of INMS with global and international policy approaches. An engagement strategy will be developed linking together the work on 'Nitrogen Champions' (T4.1.4), key messages emerging (T4.4.2) and considering 'policy intervention points'. 'Policy Intervention Points' would include focussing on pre-existing ministerial or working group meetings and engaging with groups such as GPA, OECD, UNECE, CBD to organise joint workshops on the benefits of the INMS approach. The strategy will consider the needs and timelines of regional and intergovernmental processes to allow timely introduction of messages, documents and guidance as appropriate. Throughout the project, this Task will engage with the INMS partner and stakeholder network in order to develop a strategy which is fit for purpose. The Task will also link with the ongoing work on a 'Policy Arena for Nitrogen' and emerging messages (T4.4.2).

INMS partners proposing to contribute to this activity include: NERC (UK), IITA (Africa), UNECE, SEI York (UK), EC-JRC (Europe).

2.4.3.3 Task 4.4.2 Development of a long-term strategy for INMS, including policy homes & financing models

Task Output 4.4.2: Proposal developed for how INMS can contribute next stage in the policy arena for nitrogen

Task Co-Leads: Sutton (PCU, NERC) & Cox (UNEP)

This Task will address the long-term future and sustainability of INMS, including policy homes and finance. During the PPG phase a paper was developed on 'Policy Homes for Nitrogen' (see Appendix 20), which explored potential options for future intergovernmental action on the nitrogen issue. Potential scenarios were explored, including the possibility of a new 'Convention on Nitrogen' or a widening of remit for GPA to tackle non-water related N sources. The potential of a 'Policy Arena for Nitrogen' (Figure 18.4) was also discussed, for example an inter-conventional forum where the synergies and trade-offs of nitrogen for other policies are considered. These ideas will be further investigated during INMS, in collaboration with the INMS partner and stakeholder network. A number of finance models to support the long-term work of INMS in whatever form(s) are considered, will also be developed and presented to the PPA for discussion. Emerging messages from this work will be communicated widely, to INMS partners, to UNEA and other intergovernmental processes and those engaging in INMS outreach, such as 'Nitrogen Champions' (T4.1.4).

INMS partners proposing to contribute to this activity include: NERC (UK), UNEP, UNECE, CBD, IITA (Africa), VU, ECN (the Netherlands), SEI York (UK), FAO.

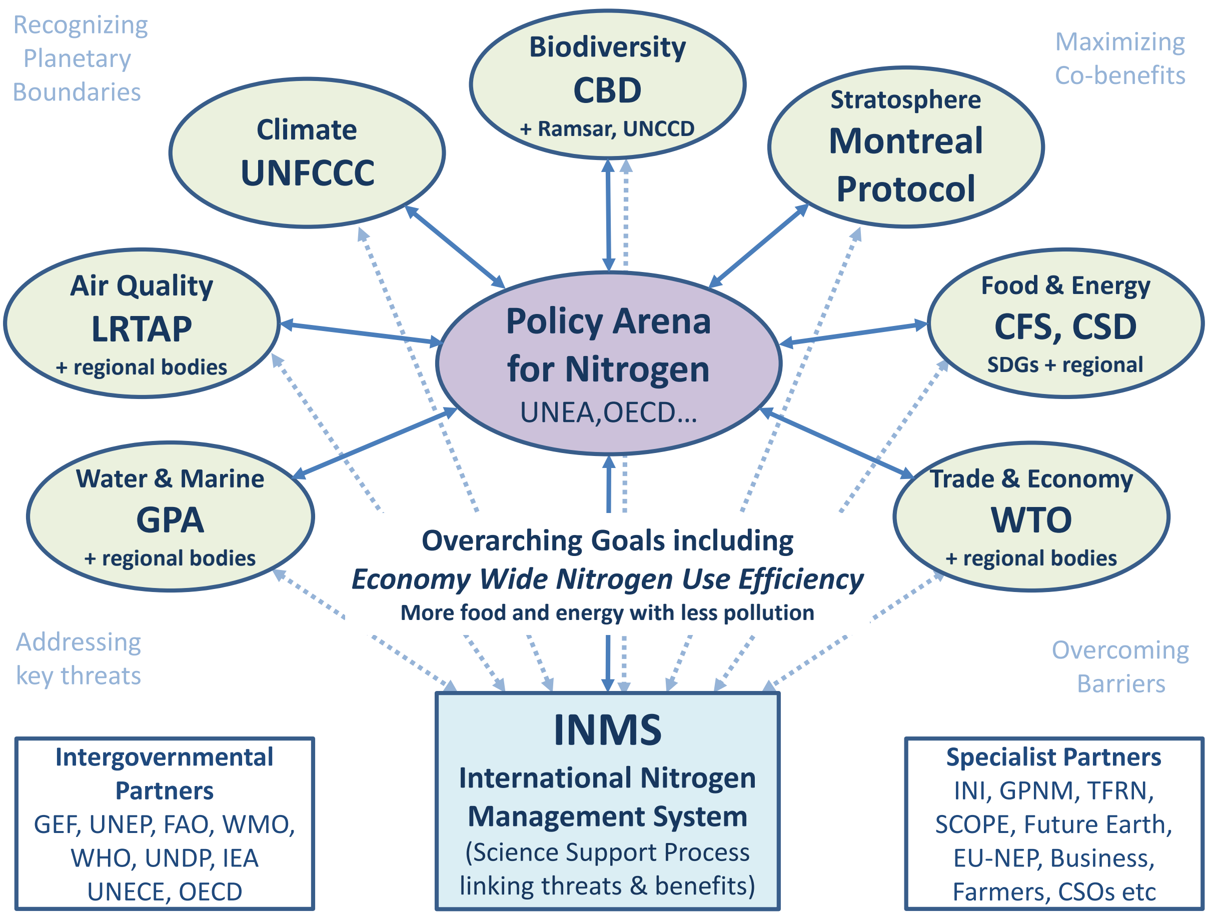

Figure A18.4: *Extended view of the Policy Arena for Nitrogen, as revised following partner and stakeholder discussion INMS First Plenary, Lisbon 2015.*

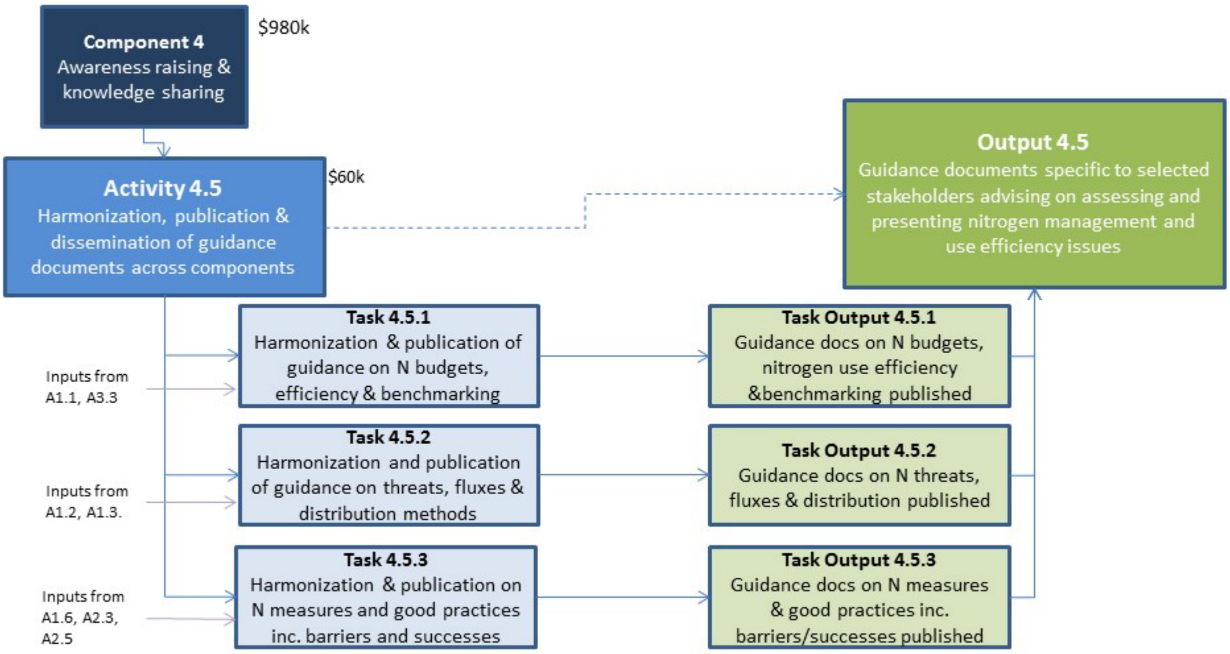

Figure 18.5: *Summary of Tasks and Task Outputs needed to reach the overall Outputs in relation to harmonization, publication & dissemination of guidance documents across components.*

2.4.4 Activity 4.5 Harmonization, publication & dissemination of guidance documents across components

Output 4.5: Guidance documents specific to selected stakeholders advising on assessing and presenting nitrogen management and use efficiency issues

Activity Co-Leads: INI (Howard, PCU, NERC) and INI (Bleeker, PBL).

The elements of this activity are summarized visually in Figure A18.5. Several guidance documents are planned across the project, including several on nitrogen budgets (A1.1), threats (T1.2.4), fluxes (T1.3.4), good practices (T2.3.4) and addressing barriers to change (T1.6.4). In order to raise the profile of the emerging guidance documents and ensure that they are fit for purpose, a co-ordinated approach to messages, publishing style and dissemination is needed. This Activity will engage with each relevant Task as documents are developed and across the project on harmonizing messages and publication styling as relevant. A dissemination strategy for the guidance documents will be developed, which will also consider the target processes and experts concerned and link with the wider communication strategy and methods adopted for the project (A4.1).

This activity will be conducted by the PCU.

2.4.4.1 Task 4.5.1: Harmonization & publication of guidance on N budgets, efficiency & benchmarking

Task Output 4.5.1: Guidance docs on N budgets, nitrogen use efficiency & benchmarking published

Task Co-Leads: INI (Howard, PCU, NERC) and INI (Bleeker, PBL).

This Task will engage with communities working on the guidance documents on national Nitrogen Budgets (T1.1.1), farm budgets (T1.1.2), NUE methodology (T1.1.3), relating Level & Effect indicators to budget indicators (T1.1.4) and regional perspectives on benchmarking N indicators (T3.3.2). Work will support the development of a harmonised set of documents, including consistency of messages emerging and graphics developed. The dissemination strategy for each document will consider relevant audiences and timing, including that of potential launch dates of other INMS guidance documents.

2.4.4.2 Task 4.5.2: Harmonization and publication of guidance on threats, fluxes & distribution methods

Task Output 4.5.2: Guidance docs on N threats, fluxes & distribution published

Task Co-Leads: INI (Howard, PCU, NERC) and INI (Bleeker, PBL).

This Task will engage with communities working on the guidance documents on N threat assessment methodology (T1.2.3) and N flux & distribution methods, plus international support (T1.2.4). Work will support the development of a harmonised set of documents, including consistency of messages emerging and graphics developed. The dissemination strategy for each document will consider relevant audiences and timing, including that of potential launch dates of other INMS guidance documents.

2.4.4.3 Task 4.5.3: Harmonization & publication on N measures and good practices inc. barriers and successes

Task Output 4.5.3: Guidance docs on N measures & good practices inc. barriers/successes published

Task Co-Leads: INI (Howard, PCU, NERC) and INI (Bleeker, PBL).

This Task will engage with communities working on the guidance documents on linking N forms & issues, high-lighting most promising options (T1.3.4) and global analysis & regional demos on overcoming barriers to change (T1.6.4). Work will support the development of a harmonised set of documents, including consistency of messages emerging and graphics developed. The dissemination strategy for each document will consider relevant audiences and timing, including that of potential launch dates of other INMS guidance documents.

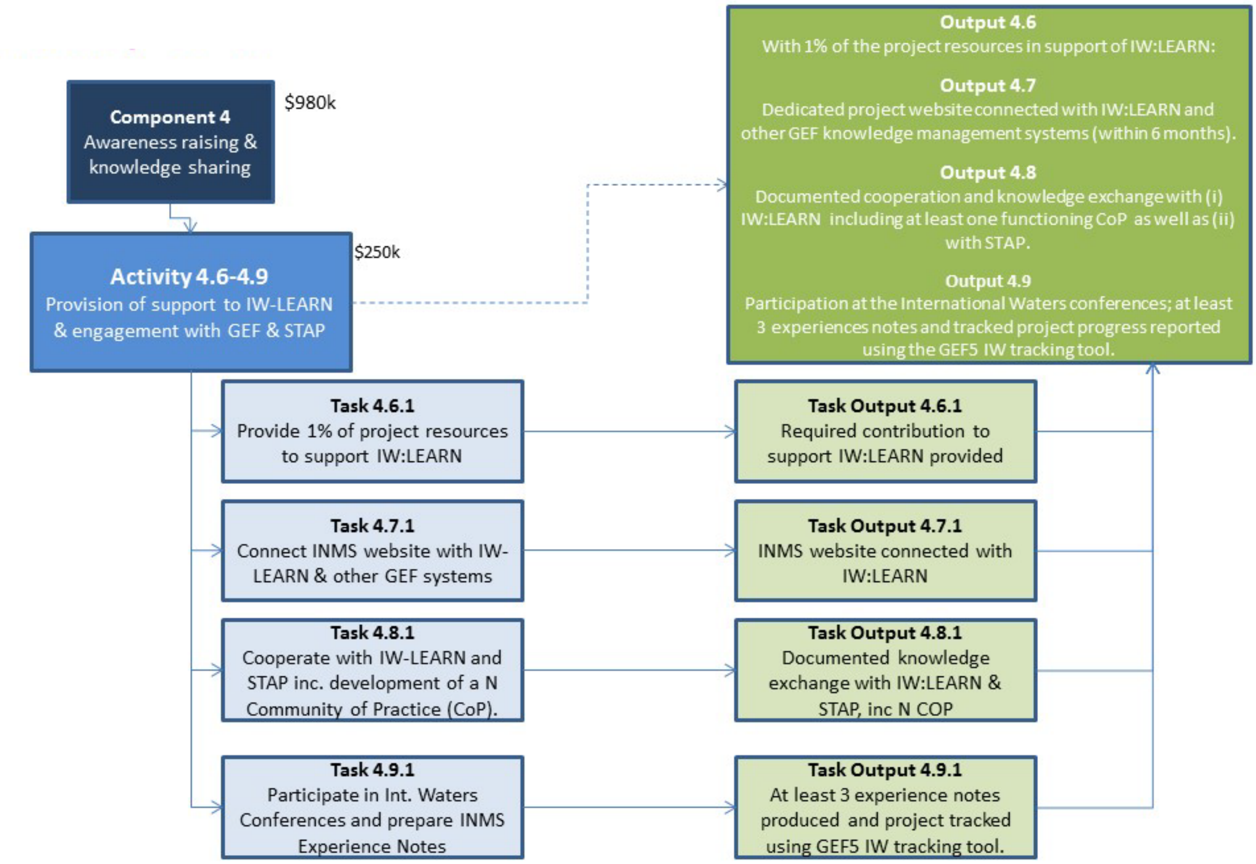

Figure 18.6: *Summary of Tasks and Task Outputs needed to reach the overall Outputs in relation to provision of support to IW-LEARN & engagement with GEF & STAP.*

2.4.5 Activity 4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP

Output 4.6: With 1% of the project resources in support of IW:LEARN
Output 4.7: Dedicated project website connected with IW:LEARN and other GEF knowledge management systems (within 6 months).
Output 4.8: Documented cooperation and knowledge exchange with (i) IW:LEARN including at least one functioning CoP as well as (ii) with STAP.
Output 4.9: Participation at the International Waters conferences; at least 3 experiences notes and tracked project progress reported using the GEF5 IW tracking tool.

Activity Co-Leads: INI (Howard, PCU, NERC) and INI (Bleeker, PBL).

The elements of this activity are summarized visually in Figure A18.6. The focus of this activity is engagement with IW:LEARN and the International Waters conferences. The INMS project will support the IW:LEARN project, through 1% co-financing. The INMS website will be linked with the IW:LEARN system and other GEF systems as appropriate (T4.7.1). An N-Community of Practice will be developed in collaboration with both IW:LEARN and the Scientific and Technical Advisory Panel (T4.8.1). Further engagement will occur through the preparation of INMS Experience Notes and active participation in International Waters conferences, during the project lifetime (T4.9.1). The relevant GEF tracking system will also be used to track the progress of the project.

These activities will be conducted through the PCU.

2.4.5.1 Task 4.6.1: Provide 1% of project resources to support IW:LEARN

Task Output 4.6.1: Required contribution to support IW:LEARN provided

Task Lead: INI (Howard, PCU, NERC)

The focus of this Task is to provide the required 1% of project costs in support of IW:LEARN.

2.4.5.2 Task 4.7.1: Connect INMS website with IW-LEARN & other GEF systems

Task Output 4.7.1: INMS website connected with IW:LEARN

Task Co-Leads: INI (Howard, PCU, NERC) and INI (Bleeker, PBL).

This Task will focus on connecting the INMS website with the IW:LEARN system and other GEF systems as appropriate. The linkage of the INMS web portal to IW:LEARN will be considered during the design phase of the system, to minimise any technical challenges in linking the two systems. An investigation into other appropriate GEF systems to link with, will be an ongoing consideration in the project.

2.4.5.3 Task 4.8.1: Cooperate with IW:LEARN and STAP including development of a N Community of Practice (CoP).

Task Output 4.8.1: Documented knowledge exchange with IW:LEARN & STAP, including N Community Of Practice

Task Co-Leads: INI (Bleeker, PBL) and INI (Howard, PCU, NERC)

This Task will focus on knowledge exchange through GEF IW:LEARN and STAP with the GEF IW portfolio. This will include the development of a Nitrogen Community of Practice (CoP) either by reinforcing the existing nutrient CoP or within the INMS web portal, aiming to promote replication of good practices in regional and global nitrogen management. The CoP will build on existing knowledge from the GEF IW portfolio (and more widely to bring external knowledge to the IW Community) and link this to the emerging messages from the INMS project. Learning needs of other projects will be considered and addressed where practicable. Knowledge and experience across projects will be shared.

INMS partners proposing to contribute to this activity include: US EPA (USA).

2.4.5.4 Task 4.9.1: Participate in International Waters Conferences and prepare INMS Experience Notes

Task Output 4.9.1: Participate in International Waters Conferences and prepare INMS Experience Notes

Task Co-Leads: INI (Howard, PCU, NERC) and INI (Bleeker, PBL).

This Task facilitates engagement with GEF International Waters community through attendance at GEF IW conferences and the preparation of Experience Notes. The INMS project will be represented at the biannual GEF IW conferences during its project cycle including showcasing the work of the demonstration activities where possible. Links to potential side-events or trainings related to nitrogen management will be explored, in collaboration GEF IW:LEARN and with other INMS training, diffusion and international relations activities (T4.2.1). At least 3 IW Experience Notes will be developed by the end of the project, sharing practical experiences in promoting better global and regional nitrogen management in the context of transboundary waters. These may take the form of practices, strategies, lessons or methodologies and may consist of ‘Video Experiences’ if practicable.

2.5 Budget

2.5.1 GEF Budget

The overall budget for Component 4 is summarized in Table A18.1 below according to the standard UNEP cost codes. This is followed by a detailed breakdown of costs by year for each of the Activities 4.1 to 4.9. An additional activity is identified that allows for technical inputs at the level of Component 4 as a whole to ensure integration.

Code	Heading	**Component 4** **A4.1**	**A4.2**	**A4.3-4.4**	**A4.5**	**A4.(**	**A4.7**	**A4.8**	**A4.9**	**A4.0**	**Total C4**
		INMS comms hub	Training & diffusion, inc N foot-printing	Support to Intl policy & long-term strategy	Harmon & Publication of guidance docs	1% to IW:LEARN	Connect INMS & IW:LEARN web sites	Coop with IW:LEARN inc CoP	Project tracking, monitoring and evaluation, attendance IW learn conf.	Comp level coord	
1161	Staff & other personnel	200	30	140	10		15	40	20	40	495
1561	Travel	10	25	35				0	10		80
2161	Contractual services	20						30	30		80
2261	Grants to implementing partners		110							40	150
4161	Materials & Supplies	20			50						70
4261	Non-expendable equipment										0
5161	Other Direct Operating costs					55					55
5581	Evaluation (consultant fees etc)								50		50
	Total	**250**	**165**	**175**	**60**	**55**	**15**	**70**	**110**	**80**	**980**

Table A18.1: *Budget overview for Component 4: 1: Awareness Raising and Knowledge Sharing (totals by Activity). Values in ‘$100K.*

Cost Code	Cost Heading	Activity 4.1 / Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	INMS communications hub	35	20	20	15	90
		Databases	35	30	30	15	110
1561	Travel	Travel for INMS communications hub and database	3	2	2	3	10
2161	Contractual services	audio visual engagement	5	5	5	5	20
2261	Grants to implementing partners	na					0
4161	Materials & Supplies	Materials and consumables	5	5	5	5	20
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**83**	**62**	**62**	**43**	**250**

Table A18.2: *Budget for Activity 4.1 Establishment and operation of INMS communications hub. Values in '$100K.*

Cost Code	Cost Heading	Activity 4.2 / Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Support for training & diffusion, international relations and inc N foot-printing	5	5	10	10	30
1561	Travel	Travel for training & diffusion, international relations and inc N foot-printing	4	6	7	8	25
2161	Contractual services						0
2261	Grants to implementing partners	Training in nitrogen meas, mod, mitig, tech (TO 4.2.	10	5	5	5	25
		Int.engagement to foster better understanding of I	3	4	4	4	15
		Share exp. N foot-printing (TO 4.2.3)	40	15	10	5	70
4161	Materials & Supplies	na					0
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**62**	**35**	**36**	**32**	**165**

Table A18.3: *Budget for Activity 4.2 INMS training, diffusion and international relations, including nitrogen footprinting. Values in '$100K.*

Cost Code	Cost Heading	Activities 4.3-4.4 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Support to Intl policy & long-term strategy	40	30	30	40	140
1561	Travel	Travel for Intl policy & long-term strategy	5	10	10	10	35
2161	Contractual services	na					0
2261	Grants to implementing partners	na					0
4161	Materials & Supplies	na					0
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**45**	**40**	**40**	**50**	**175**

Table A18.4: *Budget for Activities 4.3&4.4 Demonstration of INMS to provide support to international policy frameworks, & development of long-term strategy. Values in '$100K.*

Cost Code	Cost Heading	Activity 4.5 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Support to harmonization, publication &	2	2	3	3	10
1561	Travel	na					0
2161	Contractual services	na					0
2261	Grants to implementing partners	na					0
4161	Materials & Supplies	Materials and consumables	10	10	15	15	50
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	na					0
5581	Evaluation (consultant fees etc)	na					0
	Total		**12**	**12**	**18**	**18**	**60**

Table A18.5: *Budget for Activity 4.5 Harmonization, publication & dissemination of guidance documents across components. Values in '$100K.*

Cost Code	Cost Heading	Activities 4.6-4.9 Cost Item	Year 1	Year 2	Year 3	Year 4	Total
1161	Staff & other personnel	Connect INMS & IW:LEARN web sites (TO4.7.1)	3	4	4	4	15
		Cooperation with IW:LEARN inc CoP (TO4.8.1)	10	10	10	10	40
		Project tracking, monitoring and evaluation, attendance IW	5	5	5	5	20
1561	Travel	Travel to IW:LEARN conf. (TO4.9.2)	0	5	0	5	10
2161	Contractual services	Support from consultants (TO4.8.1)	5	10	5	10	30
		Support from consultants (TO4.9.1)	5	10	5	10	30
2261	Grants to implementing partners	na					0
4161	Materials & Supplies	na					0
4261	Non-expendable equipment	na					0
5161	Other Direct Operating costs	Give 1% of resources to IW:LEARN	55				55
5581	Evaluation (consultant fees etc)	Mid-term and terminal evaluation costs		20		30	50
	Total		**83**	**64**	**29**	**74**	**250**

Table A18.6: *Budget for Activities 4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP. Values in '$100K.*

2.5.2 Co-financing

***Table A18.7**: Co-financing by partner and activity*

Partner involvement	Sources of co-financing	Type	Partner name/Name of co-financier	Organisation short name	Country or International	Cash or in-kind co-financing	Total for Component 4
			Partners primarily with global focus in the project				
C1	GEF Agency	Policy support	United Nations Environment Programme	UNEP	Kenya	Cash co-financing	-
						In-kind co-financing	1,370,000
						Total Co-financing	**1,370,000**
C2	Non-ministry government body	Science and Policy Support	Natural Environment Research Council	NERC	UK	Cash co-financing	441,292
						In-kind co-financing	806,899
						Total Co-financing	1,248,191
C3	Others	Science and Policy Support	University of Edinburgh	UED	UK	Cash co-financing	-
						In-kind co-financing	360,000
						Total Co-financing	360,000
D1	Other Multilateral Agency (ies)	Science	Secretariat to the Convention on Biological Diversity	CBD	Canada	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
D2	Other Multilateral Agency (ies)	Policy support	UNECE Conventions on Transboundary Water and Transboundary Air Pollution	UNECE	Switzerland	Cash co-financing	-
						In-kind co-financing	40,000
						Total Co-financing	40,000
D3	Other Multilateral Agency (ies)	Policy support	Organisation for Economic Co-operation and development	OECD	France	Cash co-financing	-
						In-kind co-financing	150,000
						Total Co-financing	150,000
D4	Other Multilateral Agency (ies)	Science and Policy Support	Food and Agriculture Organization of United Nation	FAO - AGA	International	Cash co-financing	-
						In-kind co-financing	25,000
						Total Co-financing	25,000
D5	Other Multilateral Agency (ies)	Science	World Meteorological Organisation	WMO	Switzerland	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D6	Other Multilateral Agency (ies)	Science and Policy Support	International Institute for Applied Systems Analysis	IIASA	Austria	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D7	Other Multilateral Agency (ies)	Science and Policy Support	European Commissions, Joint Research Centre	JRC	International	Cash co-financing	-
						In-kind co-financing	255,000
						Total Co-financing	255,000
D8	Other Multilateral Agency (ies)	Science and Practices	The Interna tional Maize and Wheat Improvement Center	CIMMYT	Mexico	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D9	Non-ministry government body	Science and Policy Support	PBL Netherlands Environmental Assessment Agency	PBL	The Netherlands	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D10	Non-ministry government body	Science	National Institute for Public Health and the Environment The Netherlands	RIVM	The Netherlands	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D11	Non-ministry government body	Science and Policy Support	Italian National Agency for New Technologies, Energy and Sustainable Economic Development	ENEA	Italy	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D12	Non-ministry government body	Science and Practices	National Institute for Agronomic Research	INRA	France	Cash co-financing	-
						In-kind co-financing	44,000
						Total Co-financing	44,000
D13	Ministry government body	Science and Policy Support	United States Environmental Protection Agency	EPA	USA	Cash co-financing	-
						In-kind co-financing	365,000
						Total Co-financing	365,000
D14	Non-ministry government body	Science and Policy Support	Federal Environment Agency	UBA	Germany	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D15	Non-ministry government body	Science and Policy Support	French Agency for Environment and Energy Management	ADEME	France	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D16	Non-ministry government body	Science	Consiglio Nazionale delle Ricerche	CNR	Italy	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D17	Non-ministry government body	Science	Norwegian Meteorological Institute	MET Norway	Norway	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D18	Non-ministry government body	Science and Practices	Victorian Department of Economic Development, Jobs, Transport and Resources - Agriculture Division	DEDJTR	Australia	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D19	Others	Science and Policy Support	Alterra Wageningen University and Research Centre	ALTERRA	The Netherlands	Cash co-financing	35,090
						In-kind co-financing	27,800
						Total Co-financing	62,890
D20	Others	Science and Policy Support	Wageningen University and Research Centre, Livestock Research	WUR LR	The Netherlands	Cash co-financing	451,000
						In-kind co-financing	-
						Total Co-financing	451,000

D21	Others	Science and Policy Support	Energy research Centre of the Netherlands	ECN	The Netherlands	Cash co-financing	-
						In-kind co-financing	407,250
						Total Co-financing	407,250
D22	Others	Science and Policy Support	Vrije Universiteit	VU	The Netherlands	Cash co-financing	-
						In-kind co-financing	75,000
						Total Co-financing	75,000
D23	Others	Science and Practices	Nederlandse organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek	TNO	The Netherlands	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D24	Others	Science and Policy Support	Potsdam Institute for Climate Impact Research	PIK	Germany	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D25	Others	Science	University of Bonn	UBO	Germany	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D26	Others	Science and Practices	Leibniz Institute for Agricultural Engineering	ATB	Germany	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D27	Others	Science and Practices	Aarhus University, Department of Bioscience	AU Bios	Denmark	Cash co-financing	-
						In-kind co-financing	50,000
						Total Co-financing	50,000
D28	Others	Science and Practices	Aarhus University, Department of Agroecology	AU Agro	Demark	Cash co-financing	50,000
						In-kind co-financing	50,000
						Total Co-financing	100,000
D29	Others	Science and Practices	Aarhus University, Department of Environmental Science	AU, Envs	Denmark	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D30	Others	Science and Practices	Institute of Water Resources Engineering	ASU	Lithuania	Cash co-financing	-
						In-kind co-financing	300
						Total Co-financing	300
D31	Others	Science and Practices	Agrophysical Research Institute	ARI	Russian Federation	Cash co-financing	-
						In-kind co-financing	5,000
						Total Co-financing	5,000
D32	Others	Science Support	Institute of Physicochemical and Biological Problems in Soil Science	IPBPSS	Russian Federation	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D33	Others	Science and Practices	Instituto Superior de Agronomia (School of Agronomy) of the University of Lisbon	ISA	Portugal	Cash co-financing	-
						In-kind co-financing	30,000
						Total Co-financing	30,000
D34	Others	Science and Practices	Ataturk Horticultural Central Research Institute	ABKAE	Turkey	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D35	Others	Science and Practices	Fundacao da Faculdade de Ciencias da Universidade de Lisboa, FP	FFCUL	Portugal	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D36	Others	Policy support and Practices	Stockholm Environment Institute at York / York University	SEI York	UK	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D37	Others	Science and Practices	University of East Anglia	UEA	UK	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D38	Others	Science, Practice and Policy Support	North American Nitrogen Center	NANC	USA	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D39	Others	Science and Policy Support	New York University	NYU	USA	Cash co-financing	10,000
						In-kind co-financing	30,000
						Total Co-financing	40,000
D40	Others	Science and Practices	World Resources Institute	WRI	International	Cash co-financing	-
						In-kind co-financing	175,000
						Total Co-financing	175,000
D41	Others	Science and Practices	University of Missouri	MU	USA	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
D42	Others	Science and Practices	AgReseach Limited	AgResearch	New Zeland	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
B1	Private Sector/Business	Policy Interest and Practices	Fertilizers Europe	Fertilizers Europe	Belgium	Cash co-financing	11,000
						In-kind co-financing	-
						Total Co-financing	11,000
B2	Private Sector/Business	Science and Practices	Centre for Plant Nutrition Hanninghof, Yara GmbH & Co.KG, Germany	YARA	International	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
B3	Private Sector/Business	Science and Practices	Badische Anilin und Soda Fabrik	BASF	Germany	Cash co-financing	-
						In-kind co-financing	20,000
						Total Co-financing	**20,000**

B4	Private Sector/Business	Science and Practices	SKW Stickstoffwerke Piesteritz GmbH	SKWP	Germany	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
B5	Private Sector/Business	Science, Policy and Practices	PigCHAMP Pro Europa S.L.	PCH	Spain	Cash co-financing	140,000
						In-kind co-financing	60,000
						Total Co-financing	200,000
B6	Private Sector/Business	Policy Interest and Practices	International Fertilizer Industry Association	IFA	France	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
B7	Private Sector/Business	Science and Policy Interest	International Plant Nutrition Institute	IPNI	United States	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
B8	Private Sector/Business	Practices Development	European Agricultural Machinery	CEMA	Belgium	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
S1	Civil Society Organisation	Policy and Dissemination	Non-governmental organization New Energy	NGO "New Energy"	Ukraine	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
S2	Civil Society Organisation	Policy and Dissemination	World Wide Fund for Nature conservation	WWF	UK	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
S3	Civil Society Organisation	Policy and Dissemination	Planetary Boundary Initiative	PBI	UK	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
			Partners primarily with regional demonstration focus in the project				
			CASE 1: Developing regions with excess reactive nitrogen				
R1	Others	Science and Practices	Institute of Soil Science, Chinese Academy of Sciences	ISSCAS	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R2	Others	Science and Practices	National Institute for Agro-Environmental Sciences	NIAES	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R3	Others	Science, Practice and Policy Support	China Agricultural University	CAU - Crop	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R4	Others	Science and Practices	China Agricultural University	CAU - Soil	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R5	Others	Science and Support	Beijing Forestry University	BFU	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R6	Others	Science and Practices	Zhejiang University	ZJU	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R7	Others	Science and Practices	Chinese Academy of Science, Center for Agricultural Resources Research, Institute of Genetic and Developmental	CARR	China	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R8	Others	Science and Practices	Field Science Center for Northern Biosphere, Hokkaido University	FSCNB-HU	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R9	Others	Science and Practices	Research Faculty of Agriculture, Hokkaido University	Ag-HU	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R10	Others	Science and Practices	National Institute for Environmental Studies	NIES	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R11	Others	Science and Practices	Kyoto University	KU	Japan	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R12	Multilateral Agency	Policy Support	Partnerships in Environmental Management for the Seas of East Asia	PEMSEA	Philippines	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R13	Others	Science and Practices	Rothamsted Research	RRes	UK	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R14	Others	Science and Dissemination	Society for Conservation of Nature	SCON	National	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R15	Others	Science and Practices	BBRI Bangladesh	BRRI	Bangladesh (National)	Cash co-financing	-
						In-kind co-financing	20,000
						Total Co-financing	20,000
R16	Others	Science and Practices	CSIR-National Environmental Engineering Research Institute	NEERI	India	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R17	Multilateral Agency	Policy Support	South Asia Co-operative Environment Programme	SACEP	Sri Lanka	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R18	Others	Science Practices and Policy Support	Earth System Science Centre/National Institute For Space Research	CCST-INPE	Brazil	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-

			CASE 2: Developing regions with insufficient reactive nitrogen				
R19	Multiulateral Agency	Science and Practices	International Institute of Tropical Agriculture	IITA	International (Africa)	Cash co-financing	-
						In-kind co-financing	100,000
						Total Co-financing	100,000
R20	Multiulateral Agency	Sciense Support	Livestock Systems and Environment International Livestock Research Institute	ILRI	Kenya	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R21	Multiulateral Agency	Practice and Policy Support	Lake Victoria Commission Secretariat	LVBC	Uganda	Cash co-financing	15,000
						In-kind co-financing	40,000
						Total Co-financing	55,000
R22	Others	Science and Practices	Karlsruhe Institute of Technology	IMK-IFU	Germany	Cash co-financing	
						In-kind co-financing	
						Total Co-financing	
R23	Others	Science and Practices	Ghent University	UGENT	Belgium	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R24	Others	Science and Practices	Laboratoire d'Aérologie Observatoire Midi-Pyrénées	LA UMR 5560	France	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
			CASE 3: Nitrogen challenges for transition economies				
R25	Others	Science and Practices	Odessa National I. I. Mechnikov University	ONU	Ukraine	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R26	Others	Science and Practices	Institute of agroecology and environmental management of National Academy of Agrarian Sciences	IAEM	Ukraine	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R27	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution “Institute for Engineering and Environmental Problems in Agricultural	IEEP	Russian Federation	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R28	Non-ministry public body	Science and Practices	Federal State Budget Scientific Institution “All-Russian Scientific Research Institute for Organic	VNIIOU	Russia	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R29	Others	Science Support	Scientific Research Institute for Atmospheric Air Protection	SRI	Russian Federation	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R30	Multilateral Agency	Policy and Practices Support	Commission on the Protection of the Black Sea Against Pollution	BSC PS	Turkey	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
			CASE 4: Nitrogen challenges for developed regions with excess reactive nitrogen [without GEF resources]				
R31	Others	Science and Practices	University Pierre and Marie Curie	UPMC	France	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R32	Others	Science and Practices	Technical University of Madrid	UPM	Spain	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
R33	Others	Science Practices and Policy Support	Centro de Investigaciones Energéticas Medioambientales y Tecnológicas	CIEMAT	Spain	Cash co-financing	-
						In-kind co-financing	-
						Total Co-financing	-
						Cash co-financing	$1,153,382
						In-kind co-financing	$4,506,249
						Total	**$5,659,631**

2.6 Component workplan and timeline

2.6.1 Timeline

Component 4 operates throughout the duration of the project. The development of the INMS Communications Hub will be focused in Year 1, with updates and maintenance work in Years 2-3 to keep the site fresh and functional. In Year 4 there will be increased focus on awareness raising and engagement on the products emerging from INMS, leading up to the final report and publishing of the Global Assessment. Work on the database will occur throughout the project, but with increased focus at the start. Harmonization activities will start in Year 1, but with increased activities in Years 2&3 leading up to publication of key documents. Internal communication processes will be set up in Year 1 and maintained through Years 2-4. Engagement activities, from intergovernmental processes through to the public, will also be ongoing, with an increasing focus in Year 4. Further detail by Task is given in the next section.

2.6.2 Activity Workplans

The following nomenclature is used on the diagrams below:

M = Meeting, **R**= Report (includes other publications), **W** = Workshop, **S** = Communication Strategy, **MR** = Mid-term Report, **TR** = Terminal Report, **I** = Project website

Activity 4.1 **Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement)**	**Year 1**				**Year 2**				**Year 3**				**Year 4**			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Task 4.1.1 **Establishment, population & operation of INMS web portal**	**I**															
Task 4.1.2 **Establishment & maintenance of INMS database including links to other data sources**																
Task 4.1.3 **Develop communications function for INMS partners**	**S**															
Task 4.1.4 **Develop press and public engagement function for INMS**		**S**														
Monitoring and Evaluation					**R**				**R**				**R**			**R**

Activity 4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4
Task 4.2.1 **Training in nitrogen measurement, modelling and mitigation techniques**					M				R					W		R
Task 4.2.2 **International engagement of the project to foster better understanding of N challenges**				R										R		
Task 4.2.3 **Share experiences on N foot-printing as a means of developing public awareness**						W		R			W			R		
Monitoring and Evaluation					R				R				R			R

Activity 4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & development of long-term strategy	Year 1				Year 2				Year 3				Year 4			
	Q 1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4	Q1	Q 2	Q 3	Q 4
Task 4.3.1 **Development of synthesis to demonstrate INMS in support of GPA objectives**					M				M				M			
Task 4.4.1 **Coordination of INMS inputs to other policy processes**						M			M			M			M	
Task 4.4.2 **Development of a long-term strategy for INMS, inc. policy homes & financing models**					M		R				M			R		
Monitoring and Evaluation					R				R				R			R

Activity 4.5 Harmonization, publication & dissemination of guidance documents across components	**Year 1**				**Year 2**				**Year 3**				**Year 4**			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 4.5.1 **Harmonization & publication of guidance on N budgets, efficiency & benchmarking**										**M**						
Task 4.5.2 **Harmonization and publication of guidance on threats, fluxes & distribution methods**												**R[1]**	**R[2]**			
Task 4.5.2 **Harmonization & publication on N measures and good practices inc. barriers and successes**													**R[3]**			**R[4]**
Monitoring and Evaluation					**R**				**R**				**R**			**R**

[1] Threats, [2] N fluxes and distribution, [3] Barriers in food production & consumption-production, [4] Good practices

Activity 4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP	**Year 1**				**Year 2**				**Year 3**				**Year 4**			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 4.6.1 **Provide 1% of project resources to support IW:LEARN**																
Task 4.7.1 **Connect INMS website with IW-LEARN & other GEF systems**																
Task 4.8.1 **Cooperate with IW-LEARN and STAP inc. development of a N Community of Practice (CoP).**						**M**										
Task 4.9.1 **Participate in Int. Waters Conferences and prepare INMS Experience Notes**									**M**							
Monitoring and Evaluation					**R**				**R**				**R**			**R**

2.7 Execution arrangements

The involvement of partners in each component and activity is based on their expressed commitments to the project. Leadership of Components and Activities will be confirmed by the Project Partners Assembly or amended at the start of the project. Figure A18.7 shows the provisional organogram used to prepare the project, subject to this confirmation.

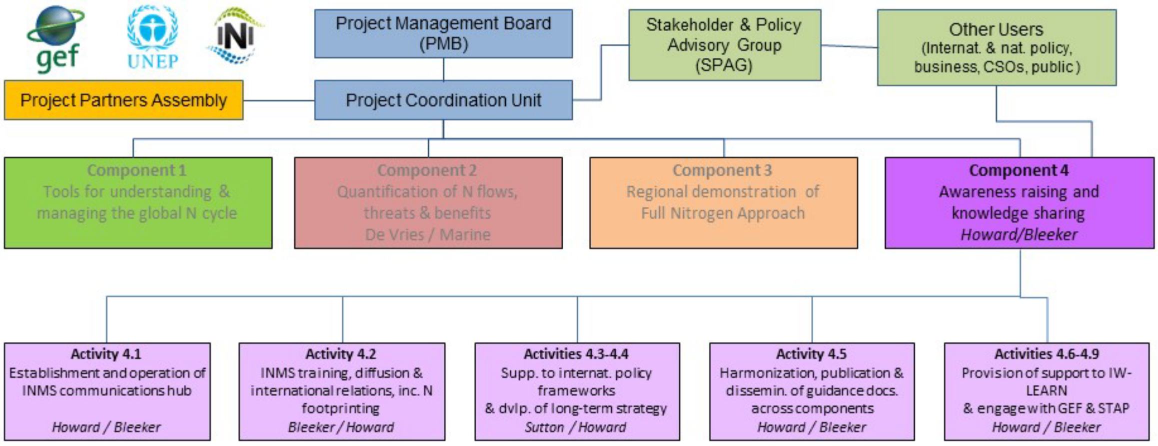

Figure A18.7: *Organogram of Component 4.*

2.8 Component M&E

Due to the nature of the activities in Component 4, including internal project communication, the development of the web portal and synthesising and harmonising activities, it will be conducted in close communication with the PCU. This will therefore include the monitoring and evaluation aspects, however the Component Leaders will be responsible for delivering the necessary Component level reports. This will enable the PCU to report to UNEP, in addition to the internal needs of progress reporting to the Project Management Board and Project Partners Assembly. Task and Activity Leaders will also be responsible for providing regular reports on progress to their respective Activity Leaders and the Component Leader, to enable them to fulfil their reporting requirements.

The Component Results Framework for Component 4 is presented in Annex 1 to this document with indicators and targets for delivery. These indicators have also been used to establish mid-term and end-of-project targets to enable the relevant external project evaluations to be completed (see Table A18.8).

Table A18.8: *Proposed mid-term and end-of-project targets*

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Activity 4.1 Establishment and operation of INMS communications hub (inc. portal, database, comms, public engagement)				
Task 4.1.1 Establishment, population & operation of INMS web portal	INMS web portal established and populated	0	INMS web portal is fully functional with dedicated content for partners, public, press	INMS web portal populated with all project reports, public engagement and training materials
ask 4.1.2 Establishment & maintenance of INMS database including links to other data sources	INMS database established and populated	0	INMS database ready for both upload and download of data, online guidance completed	INMS database populated and fully documented
Task 4.1.3 Develop communications function for INMS partners	Regular information provided to partners, through web portal, newsletters etc	0	Partner contact lists fully established. Inception meeting (1st Project Partners Assembly) and 2nd and 3rd Project Partners Assembly meetings held. Partner content fully visible on web portal 4 newsletters disseminated	Partner contact lists fully established. 4th and 5th (final) Project Partners Assembly meetings held. Partner content fully visible on web portal 8 newsletters disseminated
Task 4.1.4 Develop press and public engagement function for INMS	Press and public engagement strategy developed. Audience specific products for press and public developed Network of nitrogen champions developed	0	Press and public engagement strategy developed Web portal updated with press specific content and public engagement items Five nitrogen champions recruited and trained, nitrogen champion specific materials uploaded to web portal.	Post project press and public engagement strategy developed Web portal updated with 4 press releases and 4 engagement products (infographics/ audio/video) 15 nitrogen champions recruited and trained, nitrogen champion specific materials uploaded to web portal.
Activity 4.2 INMS training, diffusion and international relations, inc. nitrogen footprinting				

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 4.2.1 Training in nitrogen measurement, modelling and mitigation techniques	Training plan developed, trainings attended, training materials available	0	Training plan developed 1 training item added to the web portal	Post project training strategy developed 3 training items added to the web portal 1 training event held INMS contribution to Nitrogen MOOC completed
Task 4.2.2 International engagement of the project to foster better understanding of N challenges	Meetings attended, discussions of INMS held by country representatives and at meetings of intergovernmental processes	Contacts regularly attend meetings of the UNECE and GPA/UNEP and OECD	INMS discussed at 1 meeting of an intergovernmental process INMS mentioned in 1 country level report	INMS discussed at 3 meetings of an intergovernmental process INMS mentioned in 3 country level reports
Task 4.2.3 Share experiences on N foot-printing as a means of developing public awareness	Workshop attended, further N footprinting tools developed	N-Calculators in existence in United States, Netherlands, Germany & United Kingdom. Versions for Austria, Japan, Australia, China, Denmark and Tanzania are in development.	Workshop on N Footprinting held, plans for further development agreed	Experiences with N Footprinting and further developments documented, new materials available online
Activity 4.3-4.4 Demonstration of INMS to provide support to international policy frameworks, & development of long-term strategy				
Task 4.3.1 Development of synthesis to demonstrate INMS in support of GPA objectives	Key messages developed and visible. Guidance documents published and disseminated INMS Project Partners Assemblies held, with stakeholder interaction Events held jointly with intergovernmental processes and conferences		Emerging messages document developed Guidance document timeline developed 3 Project Partners Assemblies held, with associated stakeholder engagement 1 event held jointly with intergovernmental processes INMS contributes to 1 UNEA and 1 IW conference	5 Key Messages on INMS agreed and disseminated 3 guidance documents developed (as for OP4.5) 5 Project Partners Assemblies held, with associated stakeholder engagement 2 events held jointly with intergovernmental processes INMS contributes to 2 UNEA and 2 IW conferences

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 4.4.1 Coordination of INMS inputs to other policy processes	Harmonised messages emerging from the project, opportunities for 'policy intervention points' taken, engagement with Nitrogen champions.	A number of partners within the project have regular contact at national, regional and global policy levels, for example UNEP/GPA, UNECE, OECD.	Emerging messages discussed at 3rd Project Partners Assembly Policy intervention strategy developed 3 nitrogen champions of relevance to policy processes engaged with	5 key messages relevant to policy processes agreed and disseminated 3 policy intervention activities completed and documented 5 nitrogen champions of relevance to policy processes engaged with
Task 4.4.2 Development of a long-term strategy for INMS, inc. policy homes & financing models	Long-term strategy for INMS documented and communicated, including financing models	Initial Review of N Policy Homes. Discussions on 'Policy Arena for Nitrogen', held at INMS Lisbon meeting	First draft of long-term INMS strategy completed, including a list of finance models for further investigation	Final draft of long-term INMS strategy published and disseminated, including a range of costed finance models
Activity 4.5 Harmonization, publication & dissemination of guidance documents across components				
Task 4.5.1 Harmonization & publication of guidance on N budgets, efficiency & benchmarking	Publication of guidance document, common style and approach visible	0	Draft guidance publication strategy developed, considering timing, messages, and linkages to intergovernmental processes	Guidance document published and disseminated
Task 4.5.2 Harmonization and publication of guidance on threats, fluxes & distribution methods	Publication of guidance document, common style and approach visible		Draft guidance publication strategy developed, considering timing, messages, and linkages to intergovernmental processes	Guidance document published and disseminated
Task 4.5.3 Harmonization & publication on N measures and good practices inc. barriers and successes	Publication of guidance document, common style and approach visible		Draft guidance publication strategy developed, considering timing, messages, and linkages to intergovernmental processes	Guidance document published and disseminated
Activity 4.6-4.9 Provision of support to IW-LEARN & engagement with GEF & STAP				
Task 4.6.1 Provide 1% of project resources to support IW:LEARN	Participation in IW Conferences		Participate in 1 IW Conference	Participate in 2 IW Conferences
Task 4.7.1 Connect INMS website with IW-LEARN & other GEF systems	Number of links made between INMS and IW:LEARN and other IW projects		INMS website clearly linked to IW:LEARN	INMS website clearly linked to IW:LEARN

Project objective Outcomes & Outputs	Description of indicator	Baseline level	Mid-term target	End-of-project target
Task 4.8.1 Cooperate with IW-LEARN and STAP inc. development of a N Community of Practice (CoP).	Visible Nitrogen CoP on the INMS web portal		Nitrogen CoP site established on INMS web portal and populated	Nitrogen CoP site established on INMS web portal and populated
Task 4.9.1 Participate in Int. Waters Conferences and prepare INMS Experience Notes	Participation in IW Conferences, experience notes visible		Participate in 1 IW Conference 1 experience note uploaded onto INMS web portal	Participate in 2 IW Conferences 3 experience notes uploaded onto INMS web portal

Annex 1 - Component 4 Project Results Framework

Outcomes and Outputs	Indicator	Baseline	Target	Sources of Verification	Assumptions
Outcome 5: Local , national and regional expertise to address N_r issues increased and contributes to improved decision making in the Policy Arena on Nitrogen at the regional / global levels	Number of experts established and trained [SR] Number of female experts receiving travel funds to attend meetings or having received training.	Contacts established in a number of intergovernmental processes and at country level, but no formal training or information has been provided.	• Network of 15 nitrogen champions initiated, including at country representative level • 30k travel funds utilised by female participants (from project wide travel budget)	• List of nitrogen champions • Minutes of intergovernmental processes, including GPA • Meeting reports.	Country, GPA and intergovernmental buy-in to the INMS process.
Outcome 6: Improved access to and sharing of information in co-operation with IW:LEARN	INMS information available on IW:LEARN and relevant links and information shared with GPNM for addition to their web portal [P/SR]	Some information available on GPA and GPNM web portal	• Nitrogen specific information available through links from IW Learn and on INMS web portal	• Web portal	Willingness of GEF IW portfolio projects to engage on nitrogen issues
Outcome 7: Improved knowledge management with compiled knowledge and experiences about the project shared with other GEF projects and GEF Sec. and accessible on IW:LEARN.	INMS information available on IW:LEARN with links to GPA and other interested bodies [P/DR] Databases available on web portal [P] GEF IW nutrient projects report utilising INMS methods [SR]	0	• 3 experience notes • INMS Databases established and populated • INMS web portal linked to IW:LEARN • 2 GEF IW nutrient projects trial INMS methods	• INMS Web portal • Links available on IW:LEARN • Reports from GEF IW projects trialling INMS methods	Support from INMS partners to source and supply/upload necessary data into databases Willingness of GEF IW portfolio projects to engage on nitrogen issues
Outcome 8: Improved project execution from IW Conference participation and the use of the GEF5 IW indicator tracking system	IW Conference participation [P]	0	• Launch of project at IWC8 • INMS initial results presented to IWC9 • INMS final results presented to IWC10	• Reports from IW Conference	Project start date prior to IWC8.
Output 4.1: Information sharing and networking portal (with links to GPA) to assist the GPA and other bodies with uptake of understanding of N_r cycle and means to mitigate negative impacts.	Project website establishment and population, and in-use by GPA (and other bodies [P]	0	• INMS web portal created (Yr 1) • 50 members of the project web portal (Yr2) • Information on project activities regularly updated • 8 Project newsletters (2 per Yr) • 4 Press releases (1 in Yr3, 4 in Yr4) • 4 engagement products (infographics/audio/video) (1 in Yr3, 3 in Yr4) • 4 Key Messages communicated (Yr 4) • Development of a network of 'N Champions' (5 = Yr 2, 15 = Yr4)	• Web portal available to view • Membership list of website • Newsletters posted on website • Press releases posted on web portal • Engagement products posted on website • List of N Champions	Willingness for INMS partners to engage with the project web portal Buy-in to INMS process by potential Nitrogen Champions
Output 4.2: Training for regional/national experts to sustain and enhance understanding of global N cycle implementation of national indicators, diffusion of new technologies, and links between GPA and other relevant inter-governmental processes	Number of experts trained including via online/MOOCs [SR] Number of instances by countries & other intergovernmental process on N management [P] Number of regional N-footprint tools in development [P]	0 Good links with UNECE, OECD, GPA. N-Calculators in existence for selected countries.	• 1 training workshop aimed at strengthening N management (Yr 4) • 3 training items aimed at strengthening N management, including MOOC (1 = Yr 2, 3 = Yr 4) • INMS discussed at 3 intergovernmental meetings (1 = Yr 2, 3 = Yr 4) • INMS mentioned in 3 country level reports (1 = Yr 2, 3 = Yr 4) • 15 participants at a workshop on N footprinting (Yr 2)	• Report from training workshop • Training items available through website, including details on MOOC • Reports from intergovernmental meetings • Country level reports • N Footprinting workshop report	MOOC development co-financed by the activities of the NEWS India-UK Project Country, GPA and Intergovernmental buy-in to INMS concept, willingness to discuss at relevant meetings Suitable co-financing can be found to develop N Footprinting tools in further countries

Appendix 18 *INMS – Component 4*

Outcomes and Outputs	Indicator	Baseline	Target	Sources of Verification	Assumptions
Output 4.3: Overall demonstration of the International Nutrient Management System (INMS) in support of understanding the Global Nitrogen Cycle to further strengthen the GPA objectives.	Final publication & presentation of INMS approach on web portal and as part of the global assessment [P]	Materials developed in proposal stage, along with 'Initial Review of N Policy Homes' document.	• 5 Key Messages on INMS developed (Yr 4) • 5 publications (including Guidance documents under OP4.5) • 4 INMS Annual Meetings, with stakeholder engagement (1 per Yr) • 2 special workshops or side-events, at intergovernmental fora, such as UNEA, UNECE, OECD. (1 = Yr2, 2 = Yr 4) • INMS contributes to UNEA and IW conferences (Yrs 2 & 4)	• Key messages on website • Publications available • Reports from INMS meetings and stakeholder engagement • Reports from special workshops • Reports from UNEA and IW conferences	Consensus can be achieved on a core set of clear Key Messages Intergovernmental buy-in to INMS concept, willingness to jointly organise events with INMS
Output 4.4: Presentation of INMS development to UN Environment Assembly in Yrs 1 & 3	Number of staff attending UNEA meetings. [P]	0	Attendance at 2 UNEA meetings, presentation made on INMS or side-event organised. (Yrs 2 & 4)	• Reports from UNEA meetings	Availability of staff to attend (i.e. clashes with other meetings)
Output 4.5: Guidance documents specific to selected stakeholders advising on assessing and presenting nitrogen management and use efficiency issues	Published guidance documents [P]	Existing documents on National nitrogen budgets, ammonia mitigations measures (UNECE), European Nitrogen Assessment, North American Nitrogen Assessment, GNC Toolbox, NUE documentation from GPNM, EU-NEP, SDG process.	• Guidance documents on N budgets, indicators benchmarking and NUE published (Yr 4) • Guidance documents on N threats, fluxes and distribution published (Yr 4) • Guidance documents on N measures & good practices published (Yr 4)	• Publication of INMS specific guidance documents.	Support from INMS partners and wider community to both source comprehensive information on existing guidance and provide fit for purpose reviews of materials
Output 4.6: With 1% of the project resources in support of IW:LEARN:	Web portal creation [P]	0	• Web portal (Yr 1) • Online linkages made to GEF IW:LEARN (Yr 1) • Active participation in GEF IW Conferences 8&9	• Web portal • INMS project listed on IW learn	
Output 4.7: Dedicated project website connected with IW:LEARN and other GEF knowledge management systems (within 6 months).	Web portal established [P]		• Web portal connected to IW:LEARN (Yr 1)	• Web portal	
Output 4.8: Documented cooperation and knowledge exchange with (i) IW:LEARN including at least one functioning CoP as well as (ii) with STAP	Number of documents prepared for IWL [P] Number of exchanges with other GEF IW projects [P]	Actions of the GEF projects.	• Set up a Nitrogen management CoP using the INMS web portal (Yr 2) • Documented exchanges with 3 other GEF projects (Yr 4)	• CoP available to access on INMS web portal • E-mail communications, or reports	Willingness of GEF IW portfolio projects to engage on nitrogen issues
Output 4.9: Participation at the International Waters conferences; at least 3 experiences notes and tracked project progress reported using the GEF5 IW tracking tool.	Number of project related staff attending IWCs [P] Number of Experience Notes/other IWL publications [P]	0	• 3 GEF Experience Notes published (1 = Yr 2, 3 = Yr 4) • Attendance at IW Conferences (Yrs 2 & 4)	• Reports from IW Conferences • Experience notes posted onto the web portal • GEF IW Tracking Tool	Available of staff to attend (i.e. clashes). Willingness of GEF IW portfolio projects to engage on nitrogen issues

Annex 2 - Terms of Reference for Partners and Consultants

Terms of Reference for the roles of Component, Activity and Task Leader along with potential consultants, is included in Appendix 11. The remit of these roles, along with decisions on the institutions and persons taking on these roles for each Component, will be subject to endorsement by the Project Partners Assembly at the Inception meeting of the project.

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Appendix 19

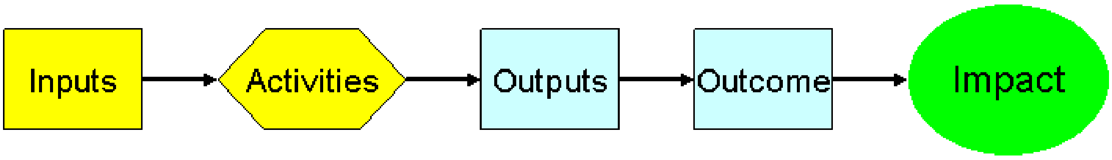
Theory of Change Analysis

Theory of Change assessment of the UNEP/GEF INMS Project

Background

Figure 1 shows a generic impact pathway which links the standard elements of project logical frameworks in a graphical representation of causal linkages. When specified with more detail, for example including the key users of outputs, the processes (the arrows) that lead to outcomes and with details of performance indicators, analysis of impact pathways can be invaluable as a tool for both project planning and evaluation.

Figure 1. A generic results chain, which can also be termed an 'Impact Pathway' or Theory of Change.



The design of the INMS project can be assessed to estimate if the intended project outcomes will lead to the expected impacts, as predicted from the Project's Objective.

Assessment

From an assessment of a 'problem tree' of the issues surrounding the environmental and other impacts/effects/problems of 'too much' and 'too little nitrogen' (Table 1, below), and the expected project activities and outputs, a theory of change relationship can be established for the project (the project overall objective is *towards* the establishment of an INMS) presented in Figure 2.

A preliminary indication of the likely changes and impacts from the INMS project are shown in Figure 2, based on the risks and assumptions presented in the Project Results Framework (Appendix 4 of the Project Document). This is expected to be updated by the both the mid-term and terminal evaluators who will utilised the results in a Review of Outcomes to Impacts (ROtI) analysis.

Table 1: Problem tree for the failure to manage/regulate excess reactive N and too little N

	Water Quality	**Air Quality**	**Greenhouse Gas warming potential***	**Ecosystems Biodiversity**	**Soil Quality**	
	Consequences of TOO MUCH Reactive N_r					**Consequences of TOO LITTLE Reactive N_r**
Overall IMPACTS	**Declining overall socio-economic conditions**					
Impacts	Loss of income from fish stocks	Costs associated with particulate N_r impacts on health	Mitigation costs	Costs to restore ecosystem health		
	Loss of income from tourism	Costs associated with regulating traffic in urban areas with high N	Adaption costs	Loss of income from tourism	Costs to rectify acidification issues and potential loss of income in agricultural settings.	Poverty increase
	Health costs from failure to remove N_r from drinking water	Loss of income from tourism – odour and visibility issues	Cost of failing to adapt to CC	Loss of revenue due to damaged forestry or agricultural products (ozone)	Loss of income from tourism.	Potential for food security risk increases
	Cost of removal of N_r from drinking water	Costs associated with specific smog events – loss of revenues, increased safety measures etc	Ecosystem, social and economic impacts from CC	Increased land-use change from natural to agricultural activities (soil mining)	Health costs from effects of heavy metal exposure.	Increased malnutrition in animals and humans (low nutrient elements in harvested crops)
				Reduced resilience of ecosystems to climate change (biodiversity,		

	Water Quality	Air Quality	Greenhouse Gas warming potential*	Ecosystems Biodiversity	Soil Quality	
	Consequences of TOO MUCH Reactive N_r					**Consequences of TOO LITTLE Reactive N_r**
				plant health, decreased carbon stocks)		
Effects	Eutrophication	Deposition of higher levels of N_r on LMEs (this includes coastal areas)	Increase of skin cancer (stratospheric O_3 depletion)	Local scale species compositional changes, including decline in biodiversity and foliar damage (can also lead to decline in carbon stocks)	Nitrate leaching through the soil (with potential release of trace elements including lead and arsenic).	N_r 'mining' of soils
	Fish kills/dead zones	Increases of ground level NO_2 and O_3 (health and visibility issues)	Climate change and increased climate variability (through the following warming effects):	Regional scale decrease in biodiversity, especially in Nr sensitive ecosystems.	Soil acidification leading to mobilization of heavy metals and effects on soil organic matter quality**.	Food insecurity
	Harmful Algal Blooms (HAB)	Formation of fine particulate matter (PM)	Warming potential of tropospheric ozone production (through radiative properties)	Enhanced susceptibility of plants to stress such as frost damage, herbivory or disease.	Atmospheric emissions of Nr from the soil.	Erosion and poor soil stability (increase in soil/sediment transport)

	Water Quality	**Air Quality**	**Greenhouse Gas warming potential***	**Ecosystems Biodiversity**	**Soil Quality**	
	Consequences of TOO MUCH Reactive N_r					**Consequences of TOO LITTLE Reactive N_r**
	Poor recreational water quality	Local odour effects (NH_3)	Warming potential of tropospheric ozone production through decreases in terrestrial C sequestration (from ozone damage)	Ozone damage to managed and un-managed ecosystems.	Biodiversity impacts for aboveground vegetation and within the soil (impacting on organic matter mineralization).	
		Indoor air pollution	Warming effect of decreasing rate of atmospheric CH_4 absorption by soils (from N deposition).		Decreased absorption of CH_4 by soils.	
Problems	N_r discharged from wastewater	Ground-level release of NO_x from vehicle combustion sources	Release of N_2O from agricultural soils (fertiliser and manure use, crop residues)	Exceedance of critical loads, from wet and dry atmospheric Nr deposition	Organic and synthetic fertiliser overuse or mis-use	Organic and synthetic fertiliser shortage or mis-use

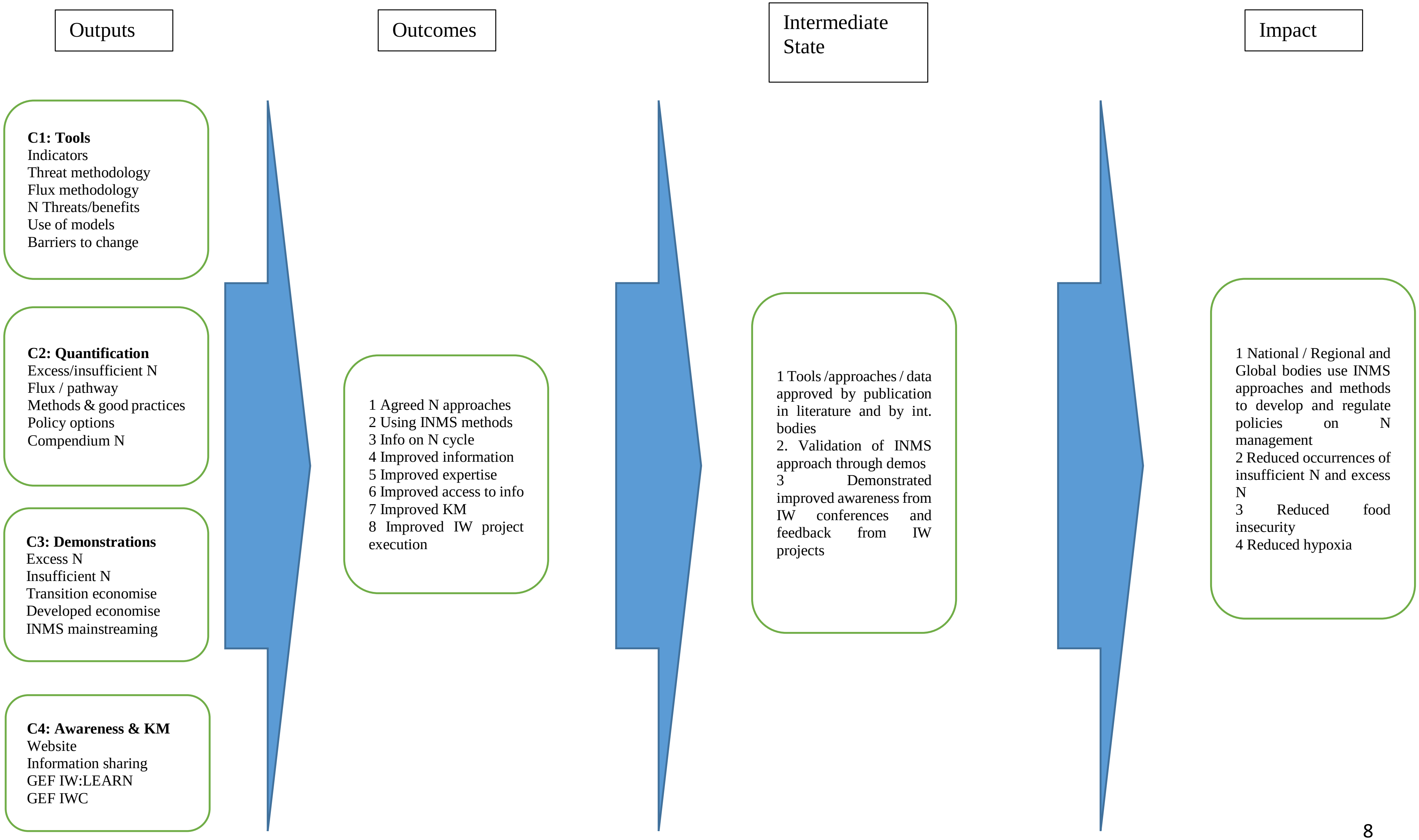
	Water Quality	Air Quality	Greenhouse Gas warming potential*	Ecosystems Biodiversity	Soil Quality	
	Consequences of TOO MUCH Reactive N_r					**Consequences of TOO LITTLE Reactive N_r**
	N_r from diffuse agriculture pollution	Ground-level release of NO_x from industry and power generation combustion sources	Release of N_2O from industrial and fossil fuel combustion	N_r discharged from wastewater and agriculture	In-efficient or damaging soil management techniques	In-efficient or damaging soil management techniques
	N_r from industry	Ground-level release of NH_3 from agriculture	Release of N_2O from household biomass burning for cooking and heating	Emissions of NOx from combustion sources (leading to increases in tropospheric ozone)		
	Atmospheric N_r deposition onto water bodies	Ground-level release of NO_x from heating and cooking combustion sources	Release of N_2O from landscape biomass burning (crop residues, intentional forest fires)			
		Release of NO_x from landscape biomass burning (crop residues, intentional forest fires)	Release of N_2O from wastewater and aquaculture (treated and untreated)			
			Emissions of NOx from combustion sources (leading to increases in			

	Water Quality	**Air Quality**	**Greenhouse Gas warming potential***	**Ecosystems Biodiversity**	**Soil Quality**	
	Consequences of TOO MUCH Reactive N_r					**Consequences of TOO LITTLE Reactive N_r**
			tropospheric ozone)			
			Atmospheric Nr emissions			

* It must also be noted that whilst a number of warming effects are triggered by N_r releases, some of these emissions also lead to cooling effects. This means that each problem and effect must not be looked at in isolation.

**In many cases acidification is avoided in managed soils through liming etc, therefore it tends to pose a greater threat to semi-natural and natural ecosystems.

Figure 2: Preliminary Theory of Change analysis of the UNEP/GEF INMS Project.



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Appendix 20

Policy Homes for Nitrogen

Context

The project review by GEF Secretariat offered the following comment: "*As pointed out in the STAP comments, the GPA has been assumed as the de facto arrangement* [for a nitrogen policy home]. *This should be analysed further in the project preparation phase, with a view to either identifying additional options, and/or providing greater focus on what is needed in the policy institution(s).*"

This question has been addressed at length in Section 3.1 of the Project Document. In addition, to further stimulate wider discussion, a manuscript is being prepared for submission to a peer review journal. The present appendix represents a first draft of this manuscript which is now being developed further to build improved understanding and consensus among partners and stakeholders.

Table of Contents

1. Concept title and authorship

From fragmented frameworks to next generation strategies: Science application for the Nitrogen Policy Arena.

Mark Sutton, David Kanter, Clare Howard, Peter Whalley, Will Brownlie and others.
Authorship to be finalized at a later date, based on contributions.

2. Summary

Human transformation of the nitrogen cycle has doubled reactive nitrogen inputs at the global scale over the past century, leading to changes across multiple environmental compartments. While the benefits of nitrogen fertilizers and biological fixation for increased crop harvest and livestock production have sustained roughly half the world population, nitrogen use is causing a combination of freshwater and marine pollution, air pollution, alteration of climate balance, stratospheric ozone loss, loss of biodiversity and soil quality, affecting human health, well-being and livelihoods. Efforts have started to bring these issues together, but there is still a high degree of fragmentation between scientific disciplines and issues.

Based on reviewing limitations in the current situation, we argue that a more joined-up approach to the global nitrogen cycle is needed. We explain how a coherent system of scientific evidence provision is being developed to support policy development though the 'International Nitrogen Management System'.

Consistent with the traditional separation of the science, current policy frameworks are equally fragmented, making it difficult to develop policies that consider the multiple impacts of nitrogen. Based on the review of existing frameworks, we highlight the need for closer policy cooperation and outline the concept of an international Policy Arena on Nitrogen. We illustrate how this could stimulate the next generation of international nitrogen strategies: maximizing the benefits of human nitrogen use, while minimizing its many environmental threats.

3. Introduction

Human perturbation of the global nitrogen cycle in the 21st century is leading both to massive benefits for food and energy production and to multiple environmental threats.[1,2] Although nitrogen is abundant in the atmosphere in its unreactive form (as N_2) this is unavailable for most organisms. At the same time, the supply of reactive nitrogen (N_r) compounds is limited under natural conditions. Anthropogenic sources have massively increased N_r formation over the last century. These include fertilizer production, crop biological nitrogen fixation, and nitrogen oxides (NO_x) from

[1] Fowler D. Pyle J.A., Raven J.A. and Sutton M.A. (2013) The global nitrogen cycle of the twenty-first century. (Special Issue) *Philosophical Transactions of the Royal Society, Series B.* **368** (1621).

[2] Sutton M.A., Bleeker A., Howard C.M., Bekunda M., Grizzetti B., de Vries W., van Grinsven H.J.M., Abrol Y.P., Adhya T.K., Billen G.,. Davidson E.A, Datta A., Diaz R., Erisman J.W., Liu X.J., Oenema O., Palm C., Raghuram N., Reis S., Scholz R.W., Sims T., Westhoek H. & Zhang F.S., with contributions from Ayyappan S., Bouwman A.F., Bustamante M., Fowler D., Galloway J.N., Gavito M.E., Garnier J., Greenwood S., Hellums D.T., Holland M., Hoysall C., Jaramillo V.J., Klimont Z., Ometto J.P., Pathak H., Plocq Fichelet V., Powlson D., Ramakrishna K., Roy A., Sanders K., Sharma C., Singh B., Singh U., Yan X.Y. & Zhang Y. (2013) *Our Nutrient World: The challenge to produce more food and energy with less pollution.* Global Overview of Nutrient Management. Edinburgh: CEH on behalf of the GPNM and INI for the United Nations Environment Program. 114 pp

combustion sources. As a result of these activities, humans have more than doubled global terrestrial rates of N_r formation.[2,3]

The benefits have been huge. It has been estimated that fertilizer N_r from the Haber-Bosch process sustain nearly 50% of the human population according to current diets, without which there would be massive problems of hunger and malnutrition in many parts of the world.[4] The increased crop production over the last century has also allowed substantial increases in livestock population, enriching human diets. In addition, agricultural N_r inputs provide a foundation for bioenergy production, offering the potential to replace fossil fuels.

Against these benefits, the environmental consequences of anthropogenic fixation of N_2 to N_r have been equally large. The overall global doubling of N_r flows has led to a web of pollution problems, often described in terms of the 'nitrogen cascade',[5] where N_r converts between many chemical forms in different environmental compartments, resulting in multiple environmental impacts. This process is driven by the dissipation of energy contained in the N_r until it is eventually 'denitrified' back to atmospheric N_2. The consequences include water pollution of both freshwater and coastal marine systems, air pollution, greenhouse gas emissions, stratospheric ozone depletion, with threats for ecosystems, biodiversity and soil quality.[2,6,7] The end result is an array of adverse impacts on health, environment and livelihoods.

The goal of intentional N_r fixation is plant and animal growth, forming many N compounds such as amino acids, proteins, enzymes and DNA. Key losses of N_r include ammonia (NH_3), nitric oxide (NO), nitrates (NO_3) and nitrous oxide (N_2O). Even denitrification losses to form N_2 are indirectly polluting, since they represent a waste of the substantial resources (2% of world energy) used to make N_r. With global efficiency of N use at around 20%,[2] it seems obvious that approaches aimed at increasing nitrogen use efficiency throughout the economy hold the simultaneous prospect to reduce N_r pollution.[8]

In recognition of these challenges, many researchers are addressing parts of the nitrogen cycle. Some focus primarily on improving the benefits of intentional N_r inputs for agricultural productivity or on improving access to N_r in agriculture.[9,10,11] Conversely, the assessment of loss pathways and impacts arising from excess nitrogen use or inadvertent N_r production is typically conducted by separate sets of researchers. The outcome of all this science, however, could hardly be said to be used to best advantage. The historical specialization of science means that many scientists

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[3] Galloway J.N., Townsend A.R., Erisman J.W., Bekunda M., Cai Z., Freney J.R., Martinelli L.A., Seitzinger S.P. and Sutton M.A. (2008) Transformation of the Nitrogen Cycle: Recent Trends, Questions and Potential Solutions. *Science*, **320**, 889-892.

[4] Erisman J.W., Sutton M.A., Galloway J.N., Klimont Z. and Winiwarter W. (2008) How a century of ammonia synthesis changed the world. *Nature Geoscience* **1**, 636-639.

[5] Galloway J.N., Aber J.D. , Erisman J.W. et al . (2003) The nitrogen cascade. *BioScience* **53**, 341-356.

[6] Sutton M.A., Howard C., Erisman J.W., Billen G., Bleeker A., Grennfelt P., van Grinsven H. and Grizzetti B. (2011) *The European Nitrogen Assessment: Sources, Effects and Policy Perspectives* (Eds.) Cambridge University Press. 612 pp.

[7] UNEP (2013) *Drawing Down N_2O to Protect Climate and the Ozone Layer.* A UNEP Synthesis Report. United Nations Environment Programme, Nairobi.

[8] Lassaletta L., Billen G., Grizzetti B., Anglade J. and Garnier J. (2014) 50 year trends in nitrogen use efficiency of world cropping systems: the relationship between yield and nitrogen input to cropland. *Environmental Research Letters* **9** 105011

[9] Raun W.R. and Johnson G.V. (1999) Improving Nitrogen Use Efficiency for Cereal Production. Agronomy Journal 91, 357-363. Add a couple of other references here on the focus of N for agriculture.

[10] Herridge D.F., Peoples M.B. and Boddey R.M. (2008) Global inputs of biological nitrogen fixation in agricultural systems. *Plant and Soil* **311**, 1-18.

[11] Vanlauwe B. and Giller K.E. (2006) Popular myths around soil fertility management in sub-Saharan Africa. *Agriculture, Ecosystems and Environment* **116**, 34-46.

addressing different parts of the nitrogen cycle find themselves speaking a different language (e.g., [12, 13, 14, 15]). It is even harder when it comes to developing the science evidence for linking the benefits of nitrogen use to minimizing the environmental threats. Few scientists are competent to cover the whole nitrogen cycle, providing a significant barrier to the provision of sound scientific evidence to underpin future policies.

We address these issues here in three stages. Firstly, we summarize the kind of scientific evidence that is needed by policy makers to inform on options for better nitrogen management. This draws on the experience of nitrogen scientists and policy analysts involved in a wide array of threats and benefits of N_r. Secondly, we review the status and nitrogen science needs of different international policy frameworks relevant to nitrogen. Specifically, we ask to what extent these frameworks offer potential to act as a primary 'policy home' for the global nitrogen challenge. Thirdly, we illustrate how the architecture is being developed to link expertise and information towards a science evidence support framework for international nitrogen policy, the 'International Nitrogen Management System' (INMS). In the process, we approach the matching policy challenge to work towards a more coherent approach among international policy frameworks. Rather than concluding on a single 'policy home' for nitrogen, we instead identify a possible model for further exploration with policymakers and other stakeholders. This is the concept of a 'nitrogen policy arena' which emphasizes the need to bring the different actors together to improve understanding and coordination among the different policy processes.

4. Science evidence to inform nitrogen policies

4.1 Why nitrogen?

The first question that needs to be asked is why special attention is needed on the nitrogen cycle. The key to this is the multiple ways that nitrogen interacts in our world, leading to both many benefits and many and diverse environmental threats. The prime benefits of reactive nitrogen (N_r) use concern food and bioenergy production, while it should not be forgotten that there are also many other benefits, such as for fibre, materials, and many other products. For example, explosives used in both mining activities and for military purposes are primarily reactive nitrogen compounds.

It is however, the unintended consequences of nitrogen use that make it of special interest. The mobility of N_r and its ability to convert into so many different chemical forms mean that human alteration of the nitrogen cycle is having major systemic consequences across all compartments of the environment. This is clearly illustrated by the figure of the 'nitrogen cascade' shown below (Figure 1). Even though this is given in a highly simplified form – for example, only a few of the major inorganic forms of nitrogen are noted, while the many organic nitrogen compounds are not shown – it already demonstrates powerfully the cross-cutting impact of nitrogen on global systems.

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[12] Clarisse L., Clerbaux C., Dentener F., Hurtmans D. and Coheur P.F. (2008) Global ammonia distribution derived from infrared satellite observations. *Nature Geoscience* **2**, 479-483.

[13] Selbie D.R., Lanigan G.J., Laughlin R.J., Di H.J., Moir J.L., Cameron K.C., Clough T.J., Watson C.J., Grant J., Somers C. and Richards K.G. (2015) Confirmation of co-denitrification in grazed grassland. *Nature Scientific Reports* **5**, 17361.

[14] Nadykto A.B., Fangqun Y., Jakovleva M.V., Herb J. and Xu Y. (2011) Amines in the Earth's Atmosphere: A Density Functional Theory Study of the Thermochemistry of Pre-Nucleation Clusters. *Entropy* **13**, 554-569.

[15] Cochlan, W.P., Herndon, J., Kudela, R.M. (2008) Inorganic and organic nitrogen uptake by the toxigenic diatom *Pseudo-nitzschia australis* (Bacillariophyceae). *Harmful Algae* 8, 111-118.

Taking a wider approach to the nitrogen cycle can therefore be catalytic in two ways. Firstly, joining up existing nitrogen science and policy responses is expected to contribute substantially to overcoming the barriers to better nitrogen management. Secondly, such a joined-up approach becomes illustrative as a case study of 'partial integration', showing how marine, freshwater, terrestrial and atmospheric scientists can work together with the matching policy domains, finding an appropriate balance between focus (here the nitrogen cycle) and integration (multiple sources, sectors, systems and effects).

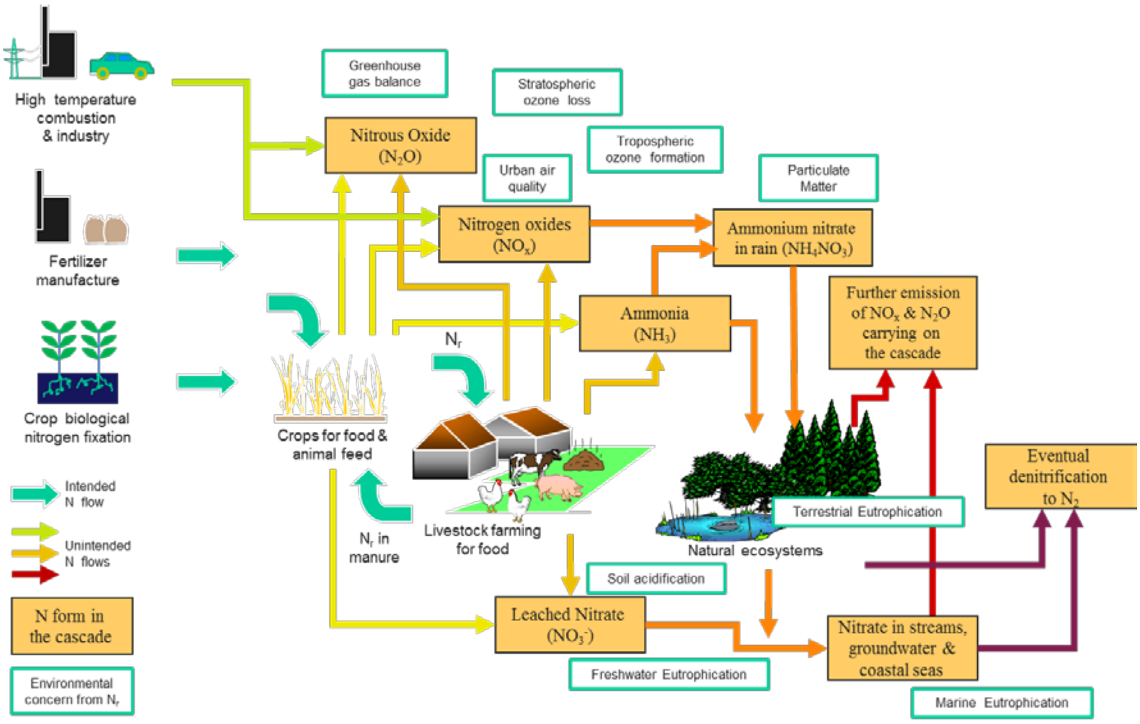

Figure 1: Simplified view of the nitrogen cascade. Nitrogen is present in low energy state as N_2 gas, so conversion to form reactive nitrogen (N_r) requires substantial energy, which is eventually dissipated in the cascade as N_r components react to make many other compounds, before eventually being denitrified back to N_2. In the process, the same nitrogen atom can contribute to several N compounds with multiple effects on the food, energy and environmental systems.

It should be emphasized that a focus on nitrogen does not exclude the interactions with other element cycles. Clearly, a balance needs to be found to allow optimal progress to be made. Addressing all issues simultaneously is likely to lead to failure. Conversely, too narrow a focus will not allow all the key interactions to be considered. The capacity for integrating research and policy areas is also expected to change over time. Identification of the optimal degree of joined-up approaches therefore needs to consider both the precedents and the institutional capacity to take the next steps.

Overall, the philosophy of developing a nitrogen approach can be considered as:

a) to ensure that the multiple benefits and impacts are considered and
b) to ensure that the primary interactions with other element cycles are recognized.

These interactions are likely to differ between contexts for different elements. For example, in aquatic systems nitrogen interactions occur with nutrient limitation of phosphorus and silica. In considering greenhouse gas emissions from terrestrial systems, the primary nitrogen interactions are with carbon compounds, including both carbon dioxide and methane. In relation to air quality threats, nitrogen interactions with sulphur emissions, as well as with volatile organic compounds, ozone and particulate matter are all relevant. These examples illustrate the systemic consequences of altering the global nitrogen cycle, while pointing to the need to optimize the right level of integration with the key aspects of these other issues and element cycles.

4.2 What kind of nitrogen science is needed?

On the one hand it is obvious that that a comprehensive and broad approach to understanding the nitrogen cycle is needed to inform policy development, both to maximize the benefits of intended N_r use and to minimize the unintended threats. In order to be robust, policies must be based on a sound scientific understanding that points to the need for fundamental detailed science on mechanisms, processes and interactions across the nitrogen cycle. If a key process is not understood or even missing this could lead the provision of misleading science advice for policy makers.

At the same time, however, it is clear that the needs of policy makers are often very practical. This means that the *application* of existing scientific knowledge is often a higher and more urgent priority than improving fundamental understanding. For example, policy makers need to make decisions where a forward-look is necessary (requiring scenarios to address 'what if' questions), while cost-benefit analysis is central to the decision making process. In the case of nitrogen, such cost-benefit analyses must be based on a full-chain of prior scientific information that starts with the magnitude of N_r flows, considers their fate and consequences, and eventually associates value with the different consequences of these flows and impacts. At the same time, the management and mitigation options of what could be done better need to be both clearly outlined and available, demonstrated with strong scientific and technical underpinning.

In painting this picture, it is worth recognizing that the global nitrogen challenge points to a very different science need than the last decades of science to underpin climate policies. ***In the first stage, the question to be asked is whether there is a problem.*** This has been the dominant paradigm of science to support climate policies over recent decades, i.e. to show whether there is human driven climate change, and if so, by how much and when. As consensus on this central question has gradually been reached, the science agenda has then turned more to a ***second stage, which focuses on identifying and quantifying impacts, as well as supporting implementation of the possible solutions.***

By contrast, there are few "nitrogen skeptics" who would argue that there is no such thing as nitrogen-induced water or air pollution. The problems of nitrogen in the environment are already widely accepted as a given. This means that research on the nitrogen challenge has long been focused on this second stage and already presses fast towards a third stage. While there continues to be a need to demonstrate the extent of nitrogen pollution threats and benefits, the priority for nitrogen evidence in the first stage focuses on improving our understanding of how N pollution problems are getting worse or better (across both space and time), and how the benefits of nitrogen to the global food system can be balanced with the costs to the environment and human health.

In entering at the second stage, the nitrogen debate therefore focuses immediately on what is the science evidence needed to provide solutions to the accepted problems. This requires information on what are the different contributions of activities to the problem and which measures, techniques and practices can be applied to reduce these problems.

It is this recognition that then pushes the science towards the ***third stage: the search for optimizing solutions to a highly complex problem***. With alteration of the nitrogen cycle leading to a combination of water pollution, air pollution, climate change, biodiversity loss, soil threats, stratospheric ozone loss and human health effects etc, this third stage focuses on the science needed to bring these problems together. Here the focus is on approaches that can help overcome the barriers to change, and demonstrating how a "nitrogen cycle approach" can support this.

The issues related to nitrogen science to support policy development were addressed as part of the 'Our Nutrient World' report for UNEP. This specifically examined what might be the main elements of a future policy approach for nutrients, and from this, what would be the science needs. Although these were framed in terms of nutrients, the articulation matches to each of the challenges faced for nitrogen. The authors identified the following priorities:

a) To establish a global assessment process for nitrogen between air, land, water, climate and biodiversity, considering the main driving forces, the interactions with food and energy security, the costs and benefits and the opportunities for the Green Economy,
b) To develop consensus on the operational indicators, with benchmarking to record progress on improving nitrogen use efficiency and reducing the adverse environmental impacts,
c) To investigate options for improvement of nitrogen use efficiency, demonstrating benefits for health, environment, and the supply of food and energy,
d) To address barriers to change, fostering education, multi-stakeholder discourse and public awareness,
e) To establish internationally agreed targets for improved N_r management at regional and planetary scales,
f) To quantify the multiple benefits of meeting the nitrogen management targets for marine, fresh-water and terrestrial ecosystems, mitigation of greenhouse gases and other climate threats, and improvement of human health,
g) To develop and implement an approach for monitoring time-bound achievement of the nitrogen management targets, and for sharing and diffusing new technologies and practices that would help to achieve the targets.

Of these goals, points a), b), c) and d) match to specific science requirements. Additional science challenges are included in both points f) and g), especially in relation to innovation and sharing technologies. By contrast, the setting of internationally agreed goals (e), while informed by science, must be the task of governments and policy makers, which needs to be addressed using relevant policy frameworks.

4.3 On what timescales is nitrogen science needed to support policy?

A classic debate between scientists and policymakers concerns the timescale of evidence provision. Science is a slow process, which takes many years to come to fruition as measurements are made, models are built and fundamental understanding deepens. By contrast, policy makers will often be operating on a tight schedule, where science advice is needed in a few weeks' time-horizon rather than several years.

It is therefore important to distinguish between the *environmental timescales of interest* to policy makers and *the timescales of when they require essential information* from the science community. For example, policymakers may wish to see trends over the past century ("how much did the problem get worse?"), trends over the past decade ("Were our policies successful?") and projections over future decades or centuries ("What will happen if we do nothing?"). In each case, scientists need several years to decades to collect and process data, deepen understanding, and then build and integrate models to be able to deliver answers to such questions. Against this recognition, policy makers may assume that the answers to their questions are already available, and that the science community can quickly deliver the answers within a matter of weeks or even days, to support the policy discussion of the moment.

The answer to this dichotomy is actually well established. It means that policy makers cannot hope to make progress with scientific underpinning of their questions by *ad hoc* or short-term policy interventions. Rather, an ongoing process of dialogue between policy makers and scientists is needed that deepens mutual understanding of each-others' needs and the feasible role of science to support policy development. This means that a viable science support process for any policy area has to be long-term. It must gradually build capacity to be able to answer policy makers' questions. Not only that, but if it is to be really successful, the science community must develop sufficient understanding to be able to forecast which questions the policy makers are going to have in the next days, months and years, even before they have asked them. This requires the establishment of a long-term partnership that builds mutual understanding of the science and policy needs, the likely priorities and the operational realities.

These reflections also point to the conditions of good policy making itself. They highlight the need for policy processes to be long-term, where the policy makers know well in advance (several years) the questions that they want to address and the anticipated timescales of evidence provision that they will require. It is critical here that a policy process is not seen as a series of isolated meetings, but is a joined-up approach towards a longer-term goal. This highlights the essential role of intercessional meetings by the bureaus of policy frameworks, which should be held between the key international negotiations. At the same time, it points to the need to involve representatives of the science community to contribute to such intercessional meetings. This is vital to ensure that the science evidence needs will be available by the time they are required.

5. Nitrogen science needs of international policy frameworks

In this section, we provide a short overview of several example international policy frameworks relevant to nitrogen. This can serve as a basis to consider both how nitrogen science is needed to support these processes and understand better the character of the main relevant frameworks.

5.1 The Global Programme of Action for the Protection of the Marine Environment from Land-based activities (GPA)

This programme works with its member states in their efforts to develop and implement national programmes of action to protect their marine environments. This includes efforts to identify and assess the nature and severity of marine water pollution problems in relation to: food security and poverty alleviation; public health; coastal and marine resources and ecosystem health, including biological diversity; and economic and social benefits and uses.

To date 77 countries have developed national programmes of actions and are in various stages of their implementation of the GPA. The GPA Third Inter-governmental Review (IGR-3) identified nutrient management as one of the core priorities for the GPA and decided to engage themselves and step up their "*efforts to develop guidance, strategies or policies on the sustainable use of nutrients so as to improve nutrient use efficiency with attendant economic benefits for all stakeholders, including farmers, and to mitigate negative environmental impacts through the* *development and implementation of national goals and plans over the period 2012-2016, as necessary*". [16]

At IGR-3, the INI was requested by UNEP to support the process delivering estimates of what a possible goal to improve nitrogen use efficiency by 20% could mean for countries and globally.[17,18] A proposal was made by some governments to use this as a basis for an aspirational goal, although such a goal was not agreed in the Manila Declaration.

The Intergovernmental reviews of GPA take place approximately every 5 years, with the next IGR scheduled for 2016 or 2017. Advance preparation with countries, supported by the technical and scientific input of INMS, could provide a key opportunity to show how improved nitrogen management can strengthen GPA's approach to meet its goals over the coming five year period.

There are many other regional seas conventions, such as the Helsinki Commission (Baltic), the Cartagena Convention (Caribbean) and the Oslo and Paris Commission (Atlantic). The GPA serves as the main intergovernmental forum to bring them together. For freshwater, the main international convention is the UNECE Convention on transboundary Water Courses (Water Convention), which has in the last years been opened for signatory by additional parties outside of the UNECE region.

5.2 Convention on Long-range Transboundary Air Pollution (LRTAP)

The UNECE Convention on Long-range Transboundary Air Pollution was established in 1979 and is now the main international framework for science and policies related to transboundary air pollution. Under the lead of its Executive Body (i.e. conference of parties), it develops and agrees policies for air pollution control, drawing on three main Working Groups: Working Group on Strategies and Review (WGSR), which develops and review strategies and policies; Working Group on Effects (WGE), which develops assessment methods and monitors the effects of air pollution; and the Steering Body of the European Monitoring and Evaluation Programme (EMEP SB), which guides the work on monitoring and modelling air pollution emissions, dispersion and deposition, including integrated assessment modelling.

The LRTAP Convention (or Air Convention for short) work by agreeing legally binding protocols for reducing air pollutant emissions and their transboundary consequences. Most relevant for nitrogen is the Gothenburg Protocol, which was signed in 1999 and revised in 2012. This includes emission ceilings for nitrogen oxides (NO_x) and ammonia (NH_3), makes mandatory requirements for emission related practices in combustion, transport and agriculture, and includes guidance on how to achieve the requirements.

The **Task Force on Reactive Nitrogen (TFRN)** is established under the WGSR of the UNECE LRTAP Convention. The TFRN was formed in 2007 by the Executive Body of the CLRTAP. It has the twin aims of providing necessary information to support revision of regional air pollution policies for nitrogen (e.g. Gothenburg Protocol Revision) and developing the vision and scientific basis to implement an integrated approach to reactive nitrogen management, counting the multiple co-benefits of taking

[16] GPA IGR-3, Manila Declaration (January 2012).

[17] UNEP (2011) Addressing the nutrient challenge: Where we are, what we need to know, and what we need to do? (UNEP/GPA/IGR3/INF/7, Dec 2011). Intergovernmental Review Meeting on the Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities. Third Session. (see para. 48).

[18] Bleeker A., Erisman J.W., Howard C.M. and Sutton M.A. (2012) Potential targets for nutrient management to be included in the Manilla declaration. Informal document prepared for the Third Inter-Governmental Review of the GPA, Manila.

action. The TFRN has developed guidance documents on NH_3 abatement[19] and on national nitrogen budget approaches (now adopted by the LRTAP Convention),[20] as well as examining the relationship between nitrogen and climate, nitrogen and food,[21] also developing the nitrogen links between the CLRTAP and the UNECE Transboundary Water Convention.

A major output of TFRN and the CLRTAP is the *European Nitrogen Assessment* (ENA). Among its findings, a key conclusion was that the environmental impact of N_r emissions in Europe at around 70 billion to 320 billion Euro per year, was of similar magnitude to the direct agricultural benefits of nitrogen use (not including the downstream benefits in the food chain).[22] In addition, through the ENA, the TFRN has developed the thinking around counting the multiple benefits of improved N use.

It is worth noting that the TFRN has benefited significantly from (and fed back into) the mature science policy support process of the CLRTAP, with well-established science and policy groups, and a strong intercessional process.[23] Finally, the TFRN and ENA have played a key role in raising public awareness of the nitrogen challenge, including developing links with business communities, civil society, communication tools (e.g. ENA video on YouTube) and public awareness through press interventions (e.g. working in partnership with the London-based Science-Media Centre). These experiences from LRTAP and TFRN have provided key lessons that can be applied to developing a global science support process for international N policy.

One of the advantages of the LRTAP model has been the close interface it fosters between the policy and science communities. This has been shown to have significant benefit in building understanding among the science community of the needs of policy makers, and vice versa.

5.3 UN Framework Convention on Climate Change (UNFCCC) and the link to the Intergovermental Panel on Climate Change (IPCC)

The United Nations Framework Convention on Climate Change (UNFCCC) is relevant for nitrogen as the Kyoto basket of greenhouse gases includes nitrous oxide (N_2O), while perturbation of the global nitrogen cycle also alters radiative budget in other ways, such as by increasing carbon sinks, by forming tropospheric ozone which reduces carbon sinks, and by forming particulate matter that has both direct and indirect cooling effects of climate.[24] The consolidation of science evidence to UNFCCC is provided through the Intergovernmental Panel on Climate Change (IPCC), which is a legally separate process. The major Assessment Reports of IPCC have delivered evidence on the science understanding of climate change as well as the mitigation and adaptation opportunities. The

[19] UNECE (2014) Guidance document on preventing and abating ammonia emissions from agricultural sources. Executive Body for the Convention on Long-range Transboundary Air Pollution. (ECE.EB/AIR/120). See also: UNECE (2015) *United Nations Economic Commission for Europe Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions*. United Nations Economic Commission for Europe, Geneva

[20] UNECE (2013) Guidance document on national nitrogen budgets. Executive Body for the Convention on Long-range Transboundary Air Pollution. (ECE.EB/AIR/119). http://www.unece.org/environmental-policy/conventions/envlrtapwelcome/guidance-documents-and-other-methodological-materials/gothenburg-protocol.html

[21] Westhoek, H. (2015) *Nitrogen on the Table: The influence of food choices on nitrogen emissions and the European environment.* (European Nitrogen Assessment Special Report on Nitrogen and Food.) Centre for Ecology and Hydrology, UK. 67 pp.

[22] Sutton M.A. et al. (2011) *The European Nitrogen Assessment*, Cambridge University Press.

[23] Reis S. et al. (2012) From Acid Rain to Climate Change. *Science* **338**, 1154

[24] See Butterbach Bahl et al. (2011) Nitrogen and the European radiative balance. In: *The European Nitrogen Assessment*, Cambridge University Press.

clear separation between IPCC and UNFCCC is notable, which may be seen as limiting the opportunity for close interaction between the science community and policy makers.

5.4 UN Convention on Biological Diversity (CBD).

The CBD is provides a broad framework for developing international cooperation and agreements on biodiversity protection. It includes twenty targets under the Aichi process of which one is focused on reducing nutrient pollution.[25] As part of this action, INI provides support as a lead partner for the nitrogen related indicator within the Biodiversity Indicators Partnership.[26] One of the advantages of the broad approach of CBD is that it is naturally able to link all different threats of alteration of the nitrogen cycle on biodiversity, including air, land and water. At the same time, this exceptionally wide breadth makes the CBD a highly complex and busy market place within which to set an agenda towards better global management of the nitrogen cycle.

5.5 Vienna Convention and the Montreal Protocol

The Vienna Convention of the Protection of the Ozone layer is a global agreement with a secretariat based at UNEP. It was adopted in 1985 and came into force in 1988, achieving universal ratification in 2009.[27] Its objective are to promote cooperation between its Parties though observations, research and information exchange on how human activities are affecting the ozone layer and to put in place measures against activities that adversely affect stratospheric ozone concentrations. The Vienna Convention is therefore highly relevant for nitrogen, since with the effective control of most ozone depleting substances (most notably CFCs and HCFCs), nitrous oxide is now estimated to be the most abundantly emitted ozone depleting substance, and will likely continue to be for the rest of the 21st century and beyond.[28] Indeed, nitrous oxide is already listed under the Vienna Convention as a substance that modifies “the chemical and physical properties of the ozone layer” (Article 3). Nevertheless, at present the Montreal Protocol, which is the main legal instrument of the Vienna Convention does not include nitrous oxide in its list of recognized ozone depleting substances. It has been suggested therefore that nitrous oxide be included.[29]

The Montreal Protocol has been recognized as being highly effective in achieving its aims of phasing out the production and consumption of 97 ozone depleting substances. This has made it attractive as a potential ‘policy home’ for nitrous oxide, and with it, potentially a joined up approach to nitrogen. Against this attractiveness, is the fact that around 70% of global nitrous oxide emissions result from agriculture, which is a sector where the Montreal Protocol has experienced the most challenges – namely the phase-out of methyl bromide, a soil fumigant. It is possible also that the high effectiveness of the Montreal Protocol results from its dealing with a small number of large companies (who have switched to producing replacement compounds) combined with appropriate financing to achieve the proposed changes. This may be contrasted with the challenges of dealing with a large number of diverse stakeholders (farmers, citizens etc), when managing the nitrogen cycle. Nevertheless, the same dynamic that existed with the major CFC companies (where they supported the Montreal Protocol because they could capitalize on the market for CFC alternatives)

[25] https://www.cbd.int/sp/targets/

[26] Bleeker A., Sutton M.A., Leach A. Erisman J.W. and Galloway J. (2012) How to meet the CBD N target for reducing critical load exceedance. Informal report to the Secretariat of the Convention on Biological Diversity. ECN Netherlands. 29 pp.

[27] http://ozone.unep.org/en/treaties-and-decisions/vienna-convention-protection-ozone-layer

[28] Ravishankara A.R., Daniel J.S. & Portmann R.W. (2009) Nitrous Oxide (N_2O): The dominant ozone-depleting substance emitted in the 21st Century. *Science* **326**, 123-125

[29] UNEP (2013) *Drawing Down N_2O to Protect Climate and the Ozone Layer.* A UNEP Synthesis Report. United Nations Environment Programme, Nairobi.

could potentially exist with most major fertilizer companies (which provide fertilizer services to help farmers adopt nitrogen best management practices and produce more efficient fertilizer products that can reduce nitrogen pollution – a growing market).

In addition to specific conventions on major societal threats, it is worth to briefly mention examples of other forums where nitrogen may be addressed.

5.6 United Nations Environment Program (UNEP), the UN Environment Assembly (UNEA) and other UN bodies.

The United Nations Environment Program hosts a large and diverse set of international actions. For example, UNEP provides the secretariat to the Montreal Protocol, to the GPA and GPMN and to the Climate and Clean Air Coalition (CCAC), which is a club of countries and other stakeholders working together to reduce short lived climate forcing emissions, especially methane and black carbon. The breadth of experience of UNEP, and close link to its mandate, could therefore make it attractive as an organization to host a more joined up approach to nitrogen.

A recent development has been the upgrading to established universal membership of United Nations countries to UNEP. This has been reflected in the change from the regular (annual to 2-yearly) meetings of the UNEP Governing Council and Global Ministerial Environmental Forum to be replaced by the United Nations Environment Assembly (UNEA). The first UNEA meeting (UNEA-1) took place during 2014, with UNEA-2 scheduled for May 2016. At such, it is still developing its character. Experience from UNEA-1 shows that it is a forum that can include attention to specific issues in parallel meetings (e.g., existing attention to heavy metals and toxic substances), while the plenary provides the opportunity for decisions as a means of promoting action by UNEP on areas of key importance. For these reasons, UNEA looks like a promising venue for further profiling development of a joined up approach to international nitrogen management.

Other United Nations Organizations whose concerns are substantially affected by human use of nitrogen include the United Nations Development Program (UNDP), the United Nations Industrial Development Organization (UNIDO), Food and Agriculture Organization (FAO), the World Meteorological Organization (WMO), the World Health Organization (WHO) and the International Oceanographic Commission of the United Nations Economic, Social and Cultural Organization (UNESCO). Further connections with these bodies are currently being developed as a means to connect nitrogen cycle issues with their priority concerns.

5.7 Organization for Economic Cooperation and Development (OECD)

The OECD represents a major global partnership consisting of 34 countries, representing much of the world economy. The OECD hosts a well-established approach to calculating national nitrogen balances in agricultural soils. This represents a key baseline that, through partnership with the Expert Panel on Nitrogen Budgets (EPNB) of the TFRN, offers a starting position in the construction of full nitrogen budget approaches. In parallel, the OECD has been exploring the concept of 'Economy-wide Nitrogen Use Efficiency'[30] as a high level indicator to complement the nitrogen budgets approaches.

Engagement of INMS with the OECD during the 'Towards INMS' PPG phase has led to the nitrogen challenge being presented to the OECD's Environmental Policy Committee (EPOC) and its Working

[30] Bleeker, A. et al. (2013) Economy-wide nitrogen balances and indicators: Concept and methodology. Organisation for Economic Cooperation and Development (OECD) (Working Party on Environmental Information), ENV/EPOC/WPEI(2012)4/REV1. Paris

Party on Water Biodiversity and Ecosystems (WPWBE), building the links with member countries to support engagement in INMS, especially through developing country case studies. As such, the OECD provides an important venue for further exploration of approaches to joined-up nitrogen management, as well as raising the profile of the challenges internationally.

6. Science to support nitrogen policy development

6.1 Experience of from existing processes

Recognizing the multi-dimensional nature of the nitrogen challenge, it is clear that there are many existing policy processes of high relevance. The consequence is that few individuals – science experts or policy makers are competent to comment on the full diversity of relevant frameworks. The elements of science provision identified in Section 4, can however, be seen as applying generically across each of the different policy frameworks. Well-organized policy development can be seen as incorporating well-organized science. In particular, there needs to be a clear process in place that develops improved mutual understanding between communities, which sets reasonable expectations on achievable timescales, and which communicates effectively between science provision and policy needs.

Before addressing the question of which is the most 'suitable policy home' for nitrogen, we therefore map out in more detail how a process of science evidence support for the global nitrogen cycle is currently being established with the support of the Global Environment Facility. This is working to develop an 'International Nitrogen Management System' (INMS), as a coordinated approach to science provision for policies on the global nitrogen cycle.

6.2 Towards the International Nitrogen Management System

INMS is a process that that is currently in development as a full project of the Global Environment Facility (GEF), where UNEP is the Implementing Agency (overall oversight) and the International Nitrogen Initiative (INI) is the Executing Agency (project delivery). As the process is one of establishment, the actual GEF project is referred to as "Towards INMS", as contrasted with an eventual International Nitrogen Management System, which does not yet fully exist.

'Towards INMS' is being developed with the recognition that the present lack of a coherency across the nitrogen cycle contributes substantially to the barriers-to-change towards a more optimized global nitrogen cycle. This means that to maximize the benefits for one policy domain (such as aquatic ecosystems and the coastal zone) requires taking account of the other benefits that possible actions could contribute. Even more, because N_r is a valuable resource, actions that simultaneously contribute to improved business efficiency and profits are likely to provide an even stronger motivation to overcome the barriers-to-change. To achieve this requires that a more joined-up science approach is delivered, with appropriate tools, options and much wider awareness of the issues.

Considering this rationale, *'Towards INMS' addresses the hypothesis that joined up management of the nitrogen cycle will offer many co-benefits that strengthen the case for action for cleaner water, cleaner air, reduced greenhouse gas emissions, better soil and biodiversity protection, while at the same time helping to meet food and energy goals*.

This leads to a broad approach where the challenges of one issue become linked to the challenges and opportunities of the interacting issues. For example, where actions needed to reduce the effects of N_r on transboundary waters can be shown simultaneously to deliver *quantified* co-benefits for air, climate, food, energy, then this will more strongly motivate the necessary changes for water protection. The same applies for each of the other threat and benefit policy domains (food, air, climate, soil etc). By acting together through the nitrogen cycle, there is the potential to transform efforts for a cleaner and healthier environment.

An initial concept for INMS, already developed in 2013, illustrates the kinds of information that are expected to be needed (Figure 2). Each of the light blue boxes represents a concept working or assessment group, which addresses issues (dark blue), supported by information (green) and models (brown). Under this original visualization, the process was particularly shown as how it may contribute to GPA as a primary receiver of science support. However, the same principles apply if such an evidence system were provided to CBD, UNFCCC, LRTAP, Vienna Convention etc.

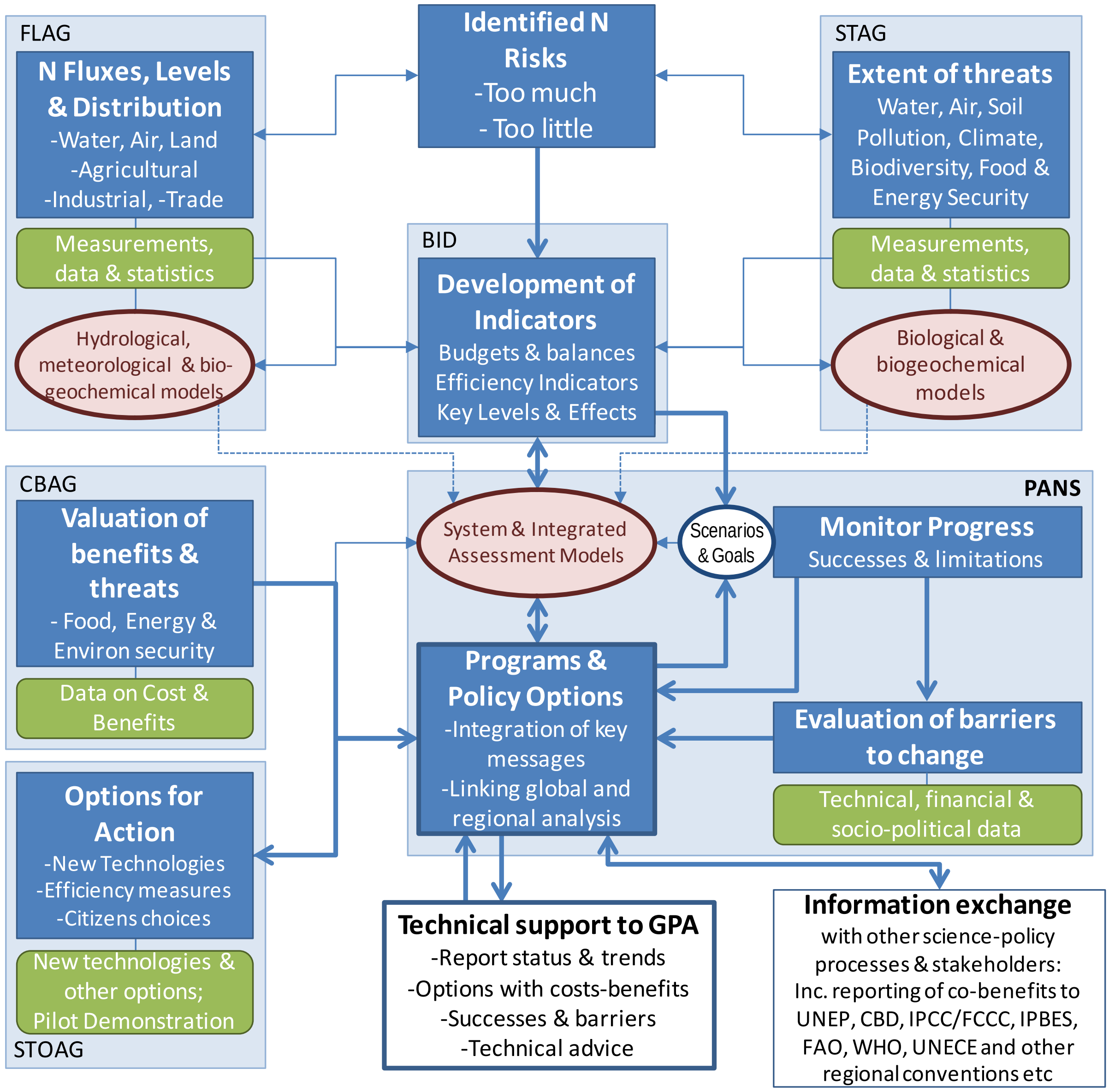

Figure 2: Initial Concept for how an International Nitrogen Management System could operate. This visualization dates from 2013, where the picture is presented from a GPA-centric viewpoint to illustrate to UNEP how INMS could support the GPA process. It should be evident, however, that the INMS outputs are equally relevant to other processes, as illustrated in the 'nitrogen policy arena' concept (Figures 4 and 5). The acronyms refer to concept advisory groups i.e. PANS: Policies and Analysis of Nitrogen/Nutrient Synergies; FLAG: Fluxes & Levels Assessment Group; STAG: Sustainability and Threats Assessment Group; BID: Budgets

and Indicators Development; CBAG: Costs & Benefits Assessment Group; STOAG: Societal & Technical Options Assessment Group.

Figure 2 is particularly based on experience from the UNECE LRTAP process, which includes a well-developed set of working groups to deliver information needed by policymakers. By contrast, such an approach is currently largely missing from the GPA, which has only been provided on an *ad hoc* basis until now. The comparison may also be made with the IPCC and the UNFCCC. Although these processes are well established and highly organized, the model proposed here indicates a much closer degree of cooperation between science and policy making communities, which is necessary to improve mutual understanding and deliver effective support.

Since Figure 2 was drafted, substantial progress has been made in bringing 'Towards INMS' to fruition as a funded project through cooperation between UNEP, INI and GEF. For this purpose, the project design has been developed consisting of four main components (C1…C4), for which the tasks and linkages are summarized in Figure 3. The present state-of-play is work to finalize the project preparation grant (PPG) phase.

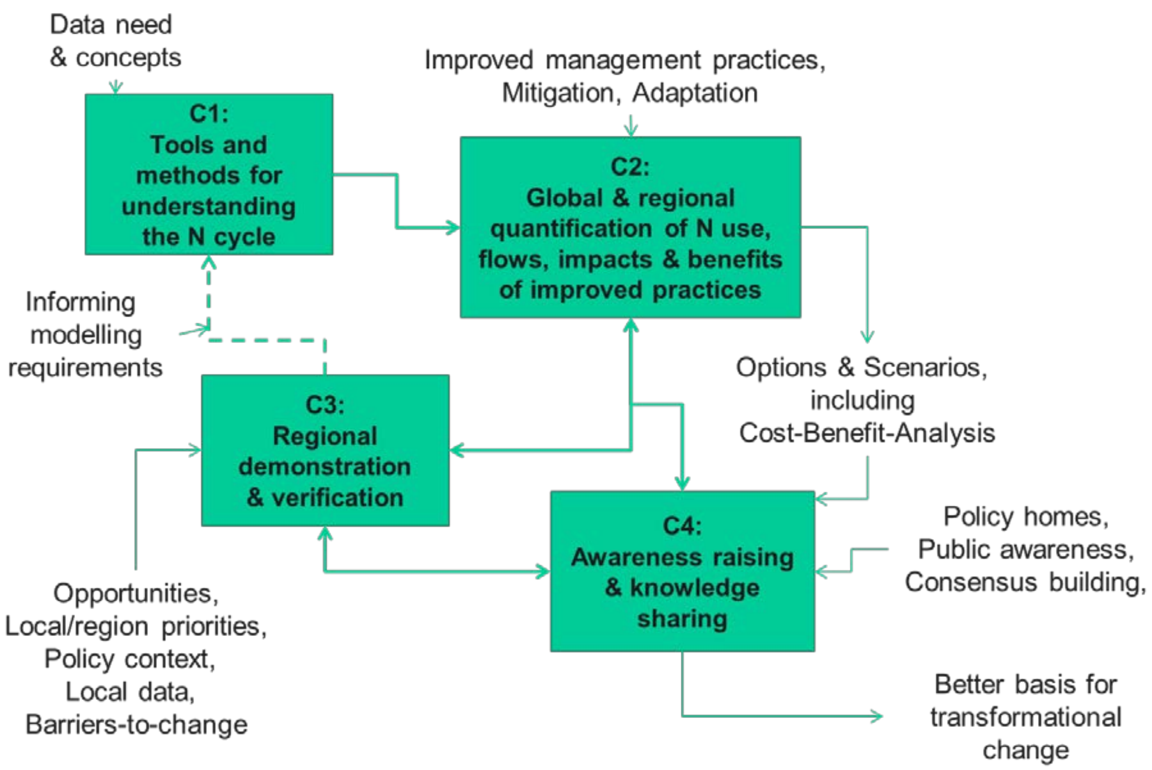

Figure 3: Simplified overview of the four main components of the 'Towards INMS' project.

6.3 Clarifying the relationship between science, policy and practice

In developing the concept of "what INMS should look like", a substantial amount of confusion has been encountered among different stakeholders about the kind of information and approach that is needed. For example, some stakeholders have pushed that INMS should itself deliver a policy process. Conversely, other stakeholders have expressed fears that INMS might become a policy process. Such ends of the spectrum appear to reflect different stakeholder views on the desirability of further developing governance concerning the global nitrogen cycle. At the same time, even the process of discussing a science evidence support process has stimulated other stakeholders to reflect on whether they want *any* form of regional or global governance for nitrogen, and if so what form should it take.

These kind of reactions show that the process of developing INMS is itself serving a useful role in stimulating thinking at the interface of science and policy. However, they also point to the need to clarify the exact role of the INMS process, both about what it is and what it is not. In responding to such questions, three parallel tracks have been identified which are important to distinguish:

***Track 1: International Policy Development for Nitrogen**:* This is the role of governments in cooperation with all stakeholders. Negotiation of agreements needs to be based on robust scientific evidence, while also requiring appropriate indicators for monitoring success, which should be based on sound science. Agreeing new policies is not the role of the science community.

Track 2: Scientific Support for Nitrogen Policy Development: This matches to the role INMS, for which the 'Towards INMS' project has been developed as key step. The role is necessarily under the lead of the science community and needs to be organized in such a way that all relevant stakeholder inputs are included, while developing an effective approach that is responsive to the needs of policy makers. Key elements of this track include providing the evidence of the multiple threats and benefits of nitrogen management, the provision of scenarios demonstrating cost-benefit of particular policy choices, including the harmonization and benchmarking of performance indicators, the sharing and dissemination of best practices, and the synthesis of indicator monitoring.

Track 3: Practices improvement for better N management: This is the role of all stakeholders, but can be particularly motivated by governments and other stakeholders. Through INMS, the science community can play a key role in identification of the most suitable options that maximize the nitrogen co-benefits, while profiling the potential of success stories for wider dissemination and adoption. Implementing wide-scale adoption of better practices is especially the role of governments and agencies.

It should be clear that **INMS is focused clearly on Track 2.** In addition 'Towards INMS' can at the same time support motivation for both Track 1 and Track 3. However, these are fundamentally parallel processes that need to operate under the lead of governments (Track 1) and government agencies and others including business and civil society (Track 3).

It may be possible to identify a **Track 4**: ***Public engagement about the nitrogen threats and opportunities***. Without significant public engagement little substantive progress can be expected in the exchange between policy making, scientific support and practice development. The key actors benefiting from N_r use and contributing to N_r pollution would have insufficient information on how to improve, while governments would not be empowered to take action by their citizens. It is therefore also important that the science process of INMS also focuses on developing clear public messages and actively engages with industry, business, media and civil society.

7. Possible models for nitrogen policy homes

With this clearer view of the kinds of science needed and ways of envisaging international nitrogen science support for policy, the next question is how to join up Tracks 1 and Track 2. It should be clear that there is currently no single policy framework that addresses all the issues relevant for nitrogen. Similarly, each of the existing frameworks, such as the GPA, CBD, LRTAP, UNFCCC, Vienna Convention and the regional seas conventions and other groups such as OECD, Commission for

Sustainable Development (including SDGs), face many challenges to making progress in meeting their goals. In the case of nitrogen, it is evident that these different topic domains hardly work together at present, with many policy opportunities not being fully grasped.

This policy landscape provides both a key challenge and opportunity for INMS. The question can be asked: if the science is to be more joined up in evidence provision, how can this foster joined-up policy making and improved adoption of the best practices? (i.e., Track 3)

Even the very development of 'Towards INMS' presses policy makers to reflect on what they would consider the most suitable architecture to address policies on the global nitrogen cycle (Track 1). The central question may be framed most simply as: What would be the most suitable policy home that INMS should eventually support?

The answer is not straight-forward as it needs to be answered not just in relation to the specific home, but the model that is used. We here outline and review three contrasting options.

7.1 Model 1: The centralized nitrogen convention

In the earliest stage of the INI discussions (going back over a decade), the fragmentation of science and policy of the nitrogen cycle was first recognized. It was this recognition that led to the establishment of the INI as a focal point to bring science evidence more closely together. At the same time, scientists were often heard to suggest that an international convention on nitrogen issues was needed. It was such calls (e.g. at the Saltsjobaden 2007 workshop) that led to the establishment of the UNECE Task Force on Reactive Nitrogen by the Executive Body of the LRTAP Convention (Decision 2007/1). Nevertheless, although the TFRN was given a mandate to address the full nitrogen cycle from a technical perspective, it still sits within a negotiating context of a specific threat (in this case air pollution). It has therefore been common to call for a new 'nitrogen convention', a call that has also appealed to journal editors given its simplicity (e.g. see the headline associated with the article in *Nature*[31] that launched the European Nitrogen Assessment).

7.2 Model 2: Work with an existing convention or programme

If this call for a 'nitrogen convention' is taken as a starting position, it is also interesting to see the response from policy makers. Through the 'corridor discussions' of many inter-governmental meetings, the INI chair has posed this question to numerous government officials. The response seems to be almost universally: "*we already have enough intergovernmental processes; we don't need more. Do your best to work with the existing processes.*"

This comment should also be seen in the context of a multi-decadal international policy cycle. To summarize broadly: The 1980s can be seen as the decade of increasing environmental recognition; the 1990s was the decade of setting up inter-governmental processes and starting to make commitments; the 2000s was the decade of realizing how difficult it is to deliver the commitments; and finally, the 2010s is the decade of avoiding new commitments and even trying to back out of existing ones. While there are exceptions, this *zeitgeist* means that the 2010s are not the ideal decade for establishing any new inter-governmental policy process.

These discussions have continued at length at the wings of numerous meetings, for example with UNEP, GPA, UNEA, CBD, UNECE (TFRN, LRTAP and the Transboundary Water Convention), OECD, European Commission and with representatives of national governments. At the same time, experience has been gained in better understanding how science can support all these processes,

[31] Sutton et al. (2011) Too much of a good thing. *Nature* (11 April 2011).

including providing the evidence necessary to support agreements on international protocols, declarations and decisions. A number of themes emerge:

1) The more specific and focused the agreement that policy makers see to make, the more specific and robust the science evidence needs to be to support that agreement.
2) A broad combination of evidence is needed, including information on temporal trends in agreed indicators, scenarios, methods to achieve the desired outcomes (technologies, practices etc), costs of taking action, scale of benefits and cost-benefit analysis.
3) Long-term policy processes with sustained intercessional activity provide the foundation for the most robust, specific and ambitious agreements. One of the reasons for this is that with sustained science input, it allows the parties to a proposed agreement access to a robust long-term body of science, to build confidence in the science evidence, and to be able to request tasks be undertaken by the science community to address their concerns. Together with an improved technical underpinning of the possible practices, it gives the countries confidence to know that their agreement is both achievable and that the benefits outweigh the costs.
4) The evidence needed by policy processes varies between rather simple to highly complex approaches. On the one hand, a simple analysis can have great power in policy context (e.g. Planetary Boundaries), while conversely, where there are objections there may be calls for more and more detail. This reflects the interface between political negotiation and science evidence, and emphasizes how the science must go beyond technical approaches also to understand the opportunities and the barriers-to-change.
5) Global policy frameworks need to be able to use evidence of varying detail, especially so as to allow data-poor areas of the world to engage fully in the process. This calls for the science community to be able to deliver a range of approaches to satisfy all needs, from those countries and regions where only basic evidence is possible (implying the need for simple indicators etc) to those developed regions where there is the call for more-sophisticated approaches to be implemented.

This list could easily be extended. It should, however, already be sufficient to illustrate the challenge for INMS to engage with countries in developing a more effective interaction between Tracks 1, 2, 3 and 4 to support better management of the global nitrogen cycle.

If the first answer to the question ‘what should be the policy home for nitrogen?’ was the call for a self-standing international ‘nitrogen convention’, then the second stage was therefore the recommendation by numerous government officials makers to use one of the existing policy frameworks.

To respond to this recommendation, it is necessary to comment on each of the main existing international policy frameworks with regard to their suitability to host an international policy approach on the nitrogen cycle. We follow here the order of the ‘WAGES’ acronym, starting with Water, and then considering the other options. It should be noted that while this is *not* intended as a critical review of these frameworks, it is inevitably necessary to reflect briefly on their most relevant strengths and limitations.

1) **WATER: Global Programme of Action to protect the marine environment from land-based activities.** (GPA) This is the only international programme to address the connection between land-based pollution and the marine environment. Since the Manila Declaration (2012), nutrients are considered as one of the three core challenges (together with waste water and marine litter) of relevance for the GPA. The nitrogen challenge is therefore closely matched to meeting GPA goals. The GPA has a key strength of working with regional marine conventions around the world. Conversely, a weakness for nitrogen is that the focus is specifically on the

marine environment. Issues of wider nitrogen management are therefore not automatically a priority, unless it can be demonstrated how joined-up nitrogen management strengthens the opportunity to meet the marine goals of the GPA. This is indeed a fair opportunity, making INMS highly relevant to GPA. The GPA also has the advantage of strong links through UNEP and GPNM communities. There is also a clear need for science evidence provision to GPA, as shown by experience at the 3rd Intergovernmental Review (IGR-3). However, as it stands, GPA lacks any solid intercessional process.[32] This means that it is currently not easy to connect science efforts between the IGR meetings (every 4-5 years) in order to support to advance planning by the countries of their desired outcomes.

2) **AIR: Convention on Long-range Transboundary Air Pollution** (LRTAP). Substantial progress has been made by the LRTAP convention in addressing the nitrogen issue and pioneering thinking connected with the wider nitrogen cycle. The LRTAP convention has a very strong intercessional process, allowing the building up of both long-term science capacity and a strong mutual understanding of needs between the policy making and science communities. In particular, through the Working Group on Strategies and Review, the architecture of the Convention allows a close interaction between policy and science expertise. Apart from its substantive commitments on N_r emissions reductions to the atmosphere, the Gothenburg Protocol took a significant step in introducing voluntary reporting of national nitrogen budgets. The limitations of the LRTAP convention for an integrated approach on the global nitrogen cycle are two-fold: Firstly, the convention is limited to goals related to air pollution, and secondly, it only covers the geographic scope of the UNECE region. Although the UNECE Transboundary Waters Convention has shown that it is possible to include Convention parties beyond this region, it has so far not proved possible to agree this within LRTAP. There is also the potential for much stronger cooperation between the UNECE LRTAP and Transboundary Waters conventions. However, these have different modes of operation, which provides a barrier to stronger linkage.

3) **GREENHOUSE GAS: Intergovernmental Panel on Climate Change** (IPCC) and the **UN Framework Convention on Climate Change** (UNFCCC). At present the UNFCCC must be one of the largest and most ambitious international agreements linked to the environment. The IPCC is also one of the world's leading science assessment processes. These are key strengths of UNFCCC as a potential policy home for nitrogen, which could for example emphasize the links between nitrogen and climate change. Against this opportunity is the complexity of dealing with an extremely large organization that is already over-busy with its own challenges. As it stands, nitrous oxide gets limited attention within the wider basket of Kyoto gases, while the chances, in practice, of embedding a 'full nitrogen approach' at the present time within UNFCCC appears to be negligible. The UNFCCC appears already to face more than enough challenges. It can also be questioned whether the UNFCCC - IPCC model offers the most suitable approach for a nitrogen policy home given the very strong separation between the science evidence (IPCC) and the negotiation process (UNFCCC). As shown by the LRTAP - TFRN approach, there are substantial benefits to be found from developing a close interface between these groups. Finally, it is unclear how the new Paris Climate Accord could help or hinder a more joined-up approach – while nitrous oxide has been included in many of the proposed country plans, the major focus still appears to be on carbon dioxide and the energy sector.

4) **ECOSYSTEMS AND BIODIVERSITY:** UN Convention on Biological Diversity (CBD). The INI already works closely with the CBD, acting as the delivery partner for its nitrogen deposition indicator under the Aichi Targets process. This has led to INI contributing to several CBD meetings, building understanding of the CBD process. At the same time, the CBD secretariat has been

[32] In principle, this might be provided through the Global conference on Land Ocean Connections (GLOC), as first held simultaneously with IGR-3 at Manila in 2012, with GLOC-2 held in Jamaica in 2014. However, the connection as an intercessional preparation for anticipated governmental agreements (e.g. with IGR-4, in 2016 or 2017) has not yet been made.

similarly active in supporting the development of 'Towards INMS'. CBD represents a highly diverse set of biodiversity interests and in this sense could be well placed to develop as an international policy home for nitrogen. On the other hand, this very same diversity and complexity can be equally considered as a barrier, as it becomes hard in the busy 'CBD market-place' to profile an issue like nitrogen, which is under strong competition for attention with many other topics. Although N_r is multi-source, multi-impact (matching to CBD), as the challenge of nitrogen is fundamentally biogeochemical, it nevertheless has a closer commonalty with other conventions dealing specifically with material flows (like GPA, LRTAP, UNFCCC).

5) **SOILS**: While the WAGES model considers soil quality as the fifth main threat of too much or too little nitrogen, there is not currently any specific intergovernmental process focusing on this threat. The closest connections could be seen with the objectives of the UN Food and Agriculture Organization (FAO) and with several of the newly adopted Sustainable Development Goals, including Goal 2 (Ending Hunger) and Goal 15 (Protecting Life on Land). While in many cases relevant for nitrogen, it is currently hard to see that these processes could be the primary policy home for nitrogen, as they either mainly focus on only one part of the story (FAO, improved food supply) or take a very generic high-level approach (SDGs) for which delivery partner organizations will anyway be necessary to make substantive progress.

6) **STRATOSPHERIC OZONE**: Vienna Convention and Montreal Protocol. In addition to the original five threats of the WAGES model, it has already been noted that N_2O now represents the main source of stratospheric ozone depletion. Given this point, it has been discussed whether N_2O control should become part of the group of pollutants that are addressed under the Montreal Protocol (as it is currently not included).[33] Advocates of its inclusion emphasize the success of the Montreal Protocol in decreasing CFC and HCFC emissions substantially over the last 20 years. Conversely, critics have emphasized that the success of the Montreal Protocol was connected with the availability of finance to support transition, while being focused on a few large well-organized companies producing CFCs and HCFCs. Although some N_2O arises from large industrial operations, over 70% arises from agricultural sources, implying the need for the Montreal Protocol to deal with a much wider and more diverse set of stakeholders than it has in the past. Though its past experience controlling methyl bromide has given the Parties to the Montreal Protocol some exposure to the agricultural sector. Irrespective of this debate, it remains an open question whether the Montreal Protocol would be ready to make a double leap to next address all the main polluting and beneficial effects of reactive nitrogen.

In addition to these issue-based international approaches, it is also worth mentioning the importance of other frameworks:

7) **Organisation for Economic Cooperation and Development** (OECD). This has experience of nitrogen and as a partner of 'Towards INMS' is engaged in mobilizing better understanding of the nitrogen cycle for policy application. OECD can be considered as a global think-tank, disseminating innovative ideas, analysis and indicators to support the economies of its member countries. OECD also provides standards and benchmarks, for example in the field of chemicals and the environment. OECD does not, however, represent any policy process with specific policy goals. In that sense, while the cooperation between 'Towards INMS' and OECD offers substantial opportunities in refining ideas and mobilizing interest across governments, a different kind of organization/framework is needed as the prime policy home for an international approach on nitrogen.

8) **Global Partnership on Nutrient Management** (GPNM) The relevance and close connection of GPNM with INMS has already been outlined, for example, with INI leading the delivery of the Global Overview on Nutrient Management 'Our Nutrient World' in cooperation with UNEP and

[33] UNEP (2013) Drawing down N_2O report.

GPNM. The GPNM was important in bringing together support to the 3rd Intergovernmental Review (IGR-3) of the GPA in Manila. While GPNM can fulfil a catalytic function as a professional network, building connections between the partners, it is clear that this is a different goal to that of an international nitrogen policy home.

9) **Climate and Clean Air Coalition** (CCAC). This is a voluntary group where countries and other stakeholders commit to take part with the common aim to reduce short lived climate polluters, especially methane and black carbon. Having identified a set of measures for reducing emissions, the CCAC promotes funding for actions to reduce these emissions as a contribution to meeting both climate and air pollution goals. As part of its agriculture programme, there is an important connection with nitrogen through manure management. Cooperation between CCAC and Towards INMS is therefore important. Nevertheless, it is clear from the focus of CCAC that it is not designed to act as the main policy home for a multi-impact approach to manage the global nitrogen cycle.

Several of these frameworks are therefore highly relevant for nitrogen. Nevertheless, the clear message is that none of the existing bodies (as they stand at present) is suited to act as a single main policy home for nitrogen. This, is of course not surprising. If the solution were easy, it would have already presented itself at an earlier stage.

7.3 Model 3: Developing the nitrogen policy arena

The comparison of these different frameworks does, however, prepare the way for a third stage. This originated during discussions in the margin of the United Nations Environment Assembly (UNEA-1, 2014) and was subsequently refined during discussions at the Environmental Policy Committee (EPOC) of the OECD (February 2015). Here the approach is intermediate between the first model (a 'nitrogen convention') and the second model ('work with existing conventions'). Under this approach, the importance is recognized of the '**policy arena for nitrogen**', which links each of the main environmental and other international frameworks. Such a policy arena is not primarily conceived as a convention in its own right, but rather as a framework that makes the links to ensure better informed policy coordination between the existing international conventions and programmes, under the lead of governments.

As can be seen from the diagram below (Figure 4), the nitrogen policy arena is seen as being served with scientific support from the International Nitrogen Management System, while providing the connections with each of the other international frameworks. In this way, establishing a focused nitrogen policy arena can be seen as a much more achievable goal. It meets both objectives of working with existing frameworks and addressing the present lack of policy coordination.

As regards a possible home for such a nitrogen policy arena, this must be a question for further discussion by countries. Both UNEA and OECD can serve as important forums in the first instance to further refine the concept and build support with countries for the approach. At a regional scale, frameworks such as UNECE, the South Asian Cooperative Environment Programme (SACEP), Partnership for Environmental Management in the Seas of East Asia (PEMSEA) and other regional bodies could serve to support and further develop the approach in cooperation with the global nitrogen policy area. The exact form and design of the Policy Arena for Nitrogen must be a matter further development. Although this concept has developed during the PPG phase of 'Towards INMS', it is a discussion that must continue with countries during the life of the project.

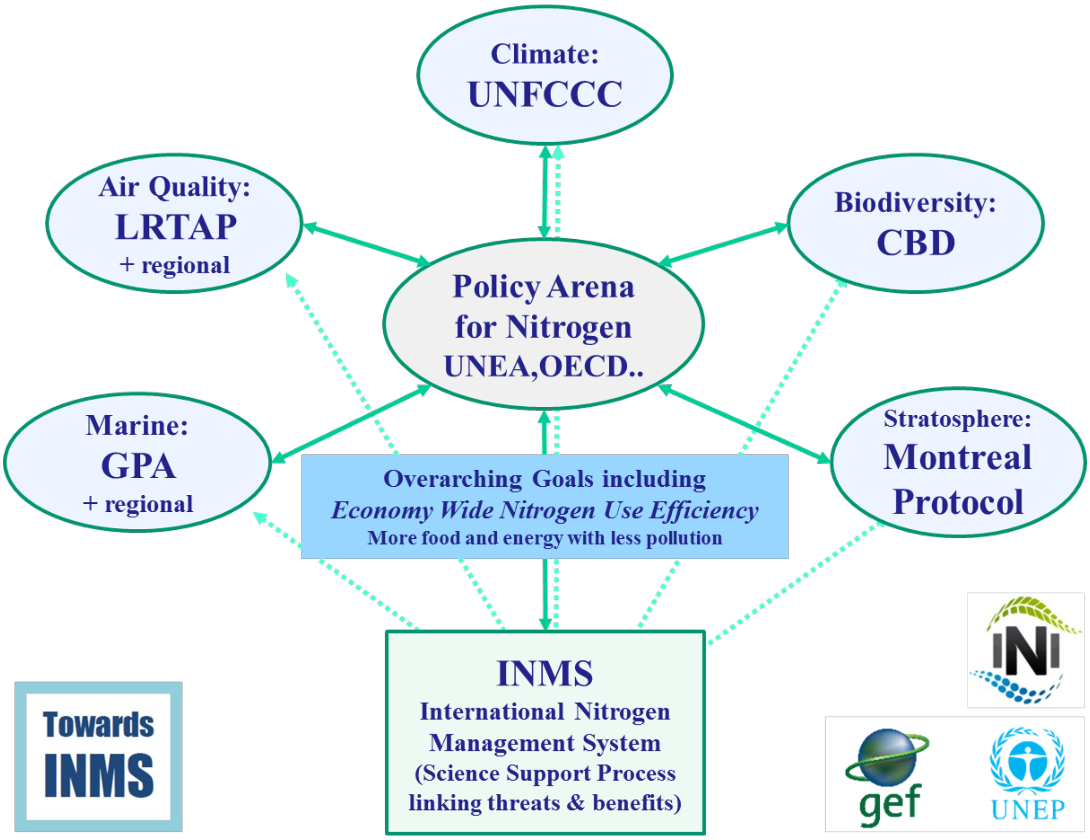

Figure 4: *Initial concept of the Policy Arena for Nitrogen showing how it may connect science support from INMS with the major effect based international agreements. Currently, these international agreements largely operate in isolation from each other failing to exploit the many synergies that operate across the global nitrogen cycle. In this approach, the policy arena provides a mechanism where governments can link their policies and strategies promoting a more optimized approach, while drawing on the scientific and technical support from INMS. Arrows also operate directly between INMS and the specific policy frameworks focusing especially on promoting improved understanding of the relevant needs as well as continuing to provide direct technical support where necessary.*

In summary, it is envisaged INMS would engage with policy frameworks at three complementary scales:

a) Strengthening science support to individual multilateral agreements, according to their topic focus (e.g. GPA, CBD, UNECE/LRTAP, UNFCCC, Vienna Convention, FAO, WHO etc),
b) Continuing to work with relevant global and regional multi-stakeholder partnerships to build deeper understanding of the cross-cutting issues (e.g. GPNM, CCAC),
c) Initiating new developments to work towards a Policy Arena for Nitrogen, engaging with overarching frameworks that could take an eventual lead (e.g. UNEA, OECD).

With the concept of the Policy Arena for Nitrogen having been developed at UNEA-1 (June 2014) and in interaction with OECD EPOC (February 2015), it was subsequently presented for discussion to the First 'Towards INMS' Plenary Meeting (Lisbon, April 2015). This allowed an open discussion of the concept chaired by UNEP, garnering wide stakeholder feedback. Overall, there was support for the concept, with no objections to the general description of relationships. Stakeholders agreed on the need for both INMS and the Nitrogen Policy Arena at the heart of the diagram. *The overall message of the stakeholders was one of high ambition to strengthen and extend the concept by increasing the* *number of linkages and goals.* If the outcome of this consultation (see Figure 5) seems rather daunting, it clearly highlights the importance of nitrogen to all these domains.

The high ambition of Figure 5 may even go beyond what is realistically feasible to achieve in 'Towards INMS' in the next four years. However, it clearly indicates a strong mandate from stakeholders to continue with the process, building the connections towards a joined-up nitrogen approach between countries, business, civil society and the global scientific community.

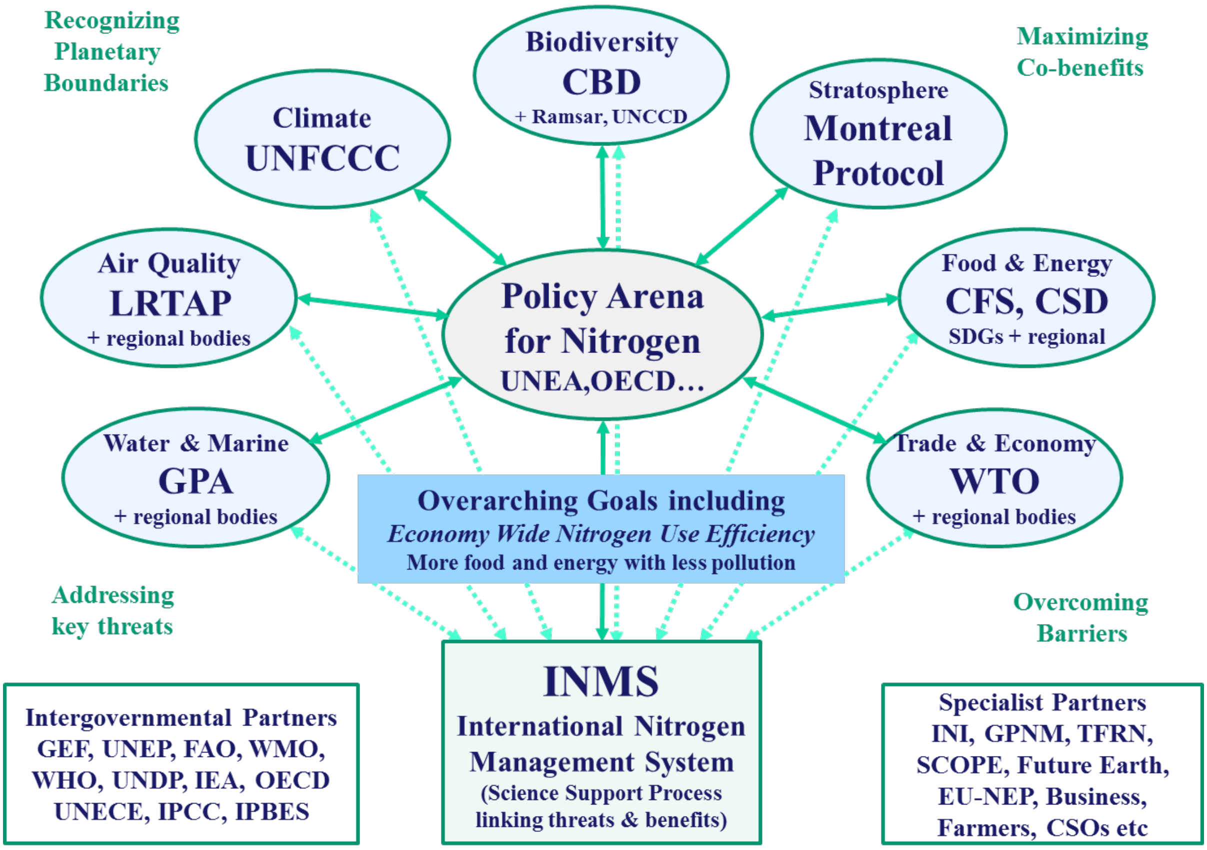

Figure 5: *Revised and extended concept of the Policy Arena for Nitrogen (Figure 3) following feedback from stakeholders during the First 'Towards INMS' plenary meeting (Lisbon, April 2015). The stakeholders indicated a high ambition to increase the number of connections, recognizing the multiple ways in which nitrogen has both benefits and threats, the needs to address barriers-to-change and the rich landscape of relevant intergovernmental and specialist partners. It remains an open question which version is most effective for public communication.*

Additional acronyms: *UNCCD is the United Nations Convention to Combat Desertification; CFS is the Committee on World Food Security; CSD is the Commission on Sustainable Development, under which Sustainable Development Goals (SDGs) are being developed; WTO is the world trade organization. WMO is the World Meteorological Organization; WHO is the World Health Organization; IPBES is the Intergovernmental Platform on Biodiversity and Ecosystem Services; IEA is the International Energy Agency, EU-NEP is the EU Nitrogen Expert Panel; SCOPE is the Scientific Committee on Problems of the Environment; CSOs is civil society organizations.*

8. Next steps

As a first discussion document, it is not the purpose of the present draft to make exact recommendations on the most suitable way forward. Following wide engagement from the different relevant communities, it is expected to use the feedback to refine the approach and to prepare a first set of working conclusions. This must naturally involve interplay between the science community, governments, business, civil society and other actors.

9. Acknowledgements

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INMS Project

GEF FULL SIZE PROJECT DOCUMENT

Appendix 22

INMS Summary

The global nitrogen challenge

Joining up the nitrogen cycle for a more sustainable world.

Nitrogen is everywhere in the world around us. In fact, 78% of every breath we take is di-nitrogen (N_2). It is extremely unreactive and provides the stabilizing medium within which we live, ensuring that oxygen in the atmosphere is safely limited to 21%. In a dry atmosphere, this leaves just 1% of argon, while other trace constituents such as carbon dioxide make up only 0.04%.

We might call this N_2 'dead nitrogen'. After all, this is the literal implication of its French word *azote*, meaning 'without life'. The German word *stickstoff* is similar, meaning 'suffocating material'. It refers to the fact that in an atmosphere of pure nitrogen we would all suffocate and die. It is a poignant reflection, for without nitrogen there would actually be no life on Earth.

Nitrogen compounds are actually the stuff of life. Proteins, amino acids, enzymes and even DNA all contain essential nitrogen. These eventually break down to form a diverse array of small nitrogen compounds such as ammonia (NH_3), nitric oxide (NO) and laughing gas (nitrous oxide, N_2O), as well as ions soluble in water such as ammonium (NH_4) and nitrate (NO_3). Each of these N forms may be recycled by biological systems, so contributing to the natural nitrogen cycle. Together they are commonly called 'reactive nitrogen' (N_r) because of the wealth of chemical and biological reactions where they play a key role.

Under natural conditions N_r compounds are mostly only available in limited supply. This is because conversion of atmospheric N_2 into N_r needs substantial amounts of energy, while this is balanced by natural destruction of N_r back to N_2, which releases substantial energy. For example, N_r is formed by bacteria though biological nitrogen fixation associated with the pea family (legumes). To do this, the plant invests part of the energy trapped by photosynthesis to get the precious N_r resource. As plants age and die, N_r is returned to the soil allowing other bacteria make their living by releasing this energy to form N_2.

Human alternation of the system

While this illustrates a balanced system, humans have greatly altered the picture. Even in Roman times, the agricultural writer Columella reported the benefits of legume crops and manures to improve soil quality. Roman farmers were already benefiting by increasing nitrogen fixation.

The 19th century was a turning point. With technological advancement in agriculture and industry, larger amounts of N_r started to be produced by humans. By the 1840s, mineral fertilizers started to be used, including 'fossil nitrogen' sources such as ammonium sulphate extracted from coal. At the same time, an increase in high temperature combustion processes, such as in transport and electricity generation, started to fix N_2 into N_r unintentionally – with nitric oxide being liberated directly in exhaust fumes.

The result was a major shift as nitrogen started to change from a scarce resource to a form of pollution. With fast growing cities, import of food was reflected in increasing levels of nitrogen-rich sewage, leading to polluted rivers high in nitrate and a plethora of other organic nitrogen forms. In the air above the cities, horses and human excreta contributed to increase ammonia levels, while higher levels of nitric oxide emission also reacted to form toxic nitrogen dioxide (NO_2) making the cocktail today known as NO_x (=NO + NO_2). Together, their products all react to produce fine particles, high in ammonium and nitrates, which reach deep into our lungs and damage human health.

The key tipping point came with the invention of an effective and relatively low-cost way of producing ammonia, from which other N_r compounds could be made. The process invented by Fritz Haber in 1908 and scaled up by Carl Bosch allowed cheap fertilizers to be produced, substantially increasing food production. At the same time, these N_r compounds were wanted to make explosives, providing the feedstock for two world wars. Overall, it has been estimated that in the 20th century there were 100 million deaths in armed conflict linked to N_r explosives while 3.5 billion births were allowed by the N_r-fuelled increase in food production. Since that time, humans have doubled global N_r flows.

As the food benefits increased, so however did the adverse consequences. The result today is a web of nitrogen pollution of water, air and land that threatens health, climate and biodiversity.

Joining up nitrogen science

Until now, most attempts to address the environmental problems resulting from nitrogen have considered only parts of the problem. Following a tendency toward scientific specialisation through the 20th century, understanding of nitrogen impacts developed in a fragmented way. The same specialist perspective was reflected in testing of the solutions and ultimately in the policies to mitigate adverse effects. The result that both the science and policy communities became separated across the nitrogen cycle. Until recently, there has been little communication between experts and policy makers for rivers, lakes and the coastal zone with those addressing the problems of nitrogen air pollution. The same goes for those addressing nitrogen and climate change and others addressing nitrogen impacts on terrestrial biodiversity. There has also been a strong separation between those with knowledge of the source sectors, such as crop and livestock agriculture, waste water and fossil fuel combustion. This has severely hampered mutual understanding on the shared opportunities for better nitrogen management.

This is where there International Nitrogen Initiative (INI) comes in to the picture. Over the last decade or so, INI has been bringing scientists together across the nitrogen cycle and developing the links with the wide range of environmental, agriculture, energy and other policy areas. Together, through the INI network, the global science community has been quietly building the foundations needed to develop the next steps toward a more joined-up response to human alternation of the nitrogen cycle.

Towards an international approach

One of the key emerging messages is that there are substantial barriers to change in improving nitrogen management. Nitrogen is a valuable resource, but not sufficiently expensive to achieve instantly the improvements necessary to avoid damaging pollution. One of the reasons for the barriers is that stakeholders only see parts of the problem, and therefore do not grasp all the benefits that improved nitrogen management would bring.

This all points to the need to take the next step: to build the ‘gravity of common cause’ across the nitrogen cycle. As a science community, we need to be able to demonstrate the multiple benefits that this would bring – how a strategic approach to nitrogen and water, for example, would give quantified co-benefits, for air, climate, stratospheric ozone depletion and biodiversity. As part of this, there is a shift to include new aspirational indicators, where a reduction in pollution becomes reframed as a positive approach toward improving nitrogen use efficiency, with benefits for innovation and jobs in the circular economy.

Together these issues are now being addressed in a new process established in partnership between the United Nations Environment Program (UNEP) and INI, with funding through the Global Environment Facility. It is being termed “Towards INMS” – developing the International Nitrogen Management System – a process of science evidence gathering and synthesis that can support international policy development. It is a way of bringing issues together, of scientists working with governments, business and civil society to identify the options for change and to help overcome the barriers.

At its heart, however, this must be a process where the world learns to know nitrogen, and citizens realise why we should all care. It is amazing that nitrogen fertilizers sustain half the human population alive today, yet so few realise its importance across all aspects of our environment. Only once they do can we expect that governments and business will be empowered to make the changes necessary. From better water treatment to smart farming practices, this is exactly where the scientific guidance of INMS will help.

Mark Sutton, Clare Howard and Will Brownlie

July 2017

Addressing fragmentation of Nitrogen-related Targets

across Multilateral Environmental Agreements

UNECE Air Convention

Gothenburg Protocol 1999 & 2012

"7. Taking into account the scientific knowledge about the hemispheric transport of air pollution, **the influence of the nitrogen cycle** and the potential synergies with and trade-offs between air pollution and climate change" establishes **national "emission reduction commitments" for NO_x and NH_3** by 2020 critical loads and critical levels for 2020, and "**minimum control measures" for NO_x and NH_3**.

No global framework

GPA

Manila Declaration 2012

"4. *Decide* actively to engage ourselves and step up our efforts to develop guidance, strategies or policies on the sustainable use of nutrients so as to improve nutrient use efficiency with attendant economic benefits for all stakeholders, including farmers, and to mitigate negative environmental impacts through the **development and implementation of national goals** and plans over the period 2012–2016, as necessary;"

US: Our Ocean Action Plan 2014

"Reduce total nutrient pollution from land-based sources to the marine environment by **20% by 2025** in order to reduce hypoxic zones and harmful algal blooms."

UNFCCC

Kyoto Protocol 1997 "3.1 The Parties… shall, individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A [inc. N_2O] do not exceed their assigned amounts… with a view to reducing their overall emissions of such gases by at least 5 per cent below 1990 levels in the commitment period 2008 to 2012"

Paris Agreement 2015 "2.1. aims to strengthen the global response…including by… b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development [inc. N_2O], in a manner that does not threaten food production."

Policy Arena for Nitrogen

UNEA,OECD..

Overarching Goals including

Economy Wide Nitrogen Use Efficiency

More food and energy with less pollution

INMS

International Nitrogen Management System

Convention on Biological Diversity

Aichi Targets 2010

Target 8: "By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity."

Key focus on nitrogen. Each country free to set its own indicators and goals.

Montreal Protocol

1987 No N_2O commitment

Recognized by the Vienna Convention. UNEP (2013): "Global anthropogenic N_2O emissions … expected to almost double by 2050 unless mitigation action is accelerated. The continued build-up of N_2O in the atmosphere will continue to deplete the stratospheric ozone layer and in so doing will to a degree undermine the achievements of the Montreal Protocol."

SDGs & Nitrogen

In development – a joined up system needed

gef UNEP Towards INMS