PROJECT TYPE: Full-sized Project
TYPE OF TRUST FUND:GEF Trust Fund

Project Identification Form (PIF)
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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 (select) (select)	GEF Agency Project ID:	01142
Other Executing Partner(s):	International Nitrogen Initiative (INI)	Submission Date: Re-submission Date:	5th April 2013 5th August 2013 16th December 2013 14th January 2014
GEF Focal Area (s):	International Waters	Project Duration (Months)	48
Name of parent program (if applicable): • For SFM/REDD+ ☐ • For SGP ☐	N/A	Agency Fee ($):	570,000

A. INDICATIVE FOCAL AREA STRATEGY FRAMEWORK[2]:

Focal Area Objectives	Trust Fund	Indicative Grant Amount ($)	Indicative Co-financing ($)
IW-3	GEFTF	6,000,000	47,622,900
Total Project Cost		**6,000,000**	**47,622,900**

B. INDICATIVE 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[3]	Expected Outcomes	Expected Outputs	Trust Fund	Indicative Grant Amount ($)	Indicative Co-financing ($)
Component 1: Tools to apply methods for understanding 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 (e.g. private sector - fertilizer producers) Methodology for threat assessment . Development of tools for valuation of the threats and benefits of N that	GEFTF	1,480,000	10,000,000

[1] Project ID number will be assigned by GEFSEC.
[2] Refer to the reference attached on the Focal Area Results Framework when completing Table A.
[3] TA includes capacity building, and research and development.

			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 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: Regional / global quantification of N use, flows, impacts and the quantitative benefits of applying best management practices	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 GEF (and others)	GEFTF	1,790,000	10,000,000

			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 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 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 accepted by the GPA	GEFTF	1,500,000	21,000,000

Component 4: Awareness raising and knowledge sharing	TA	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 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. Improved project execution from IW Conference participation and the use of the GEF5 IW indicator tracking system.	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. 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. Overall demonstration of the International Nutrient Management System (INMS) in support of understanding the Global Nitrogen Cycle to further strengthen the GPA objectives. 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). Documented cooperation and knowledge exchange with (i) IW:LEARN including at least one functioning CoP as well as (ii) with STAP.	GEFTF	940,000	6,000,000

			Participation at the International Waters conferences; at least 3 experiences notes and tracked project progress reported using the GEF5 IW tracking tool.			
Subtotal					**5,710,000**	**47,000,000**
Project Management Cost (PMC)[4]				**GEFTF**	**290,000**	**622,900**
Total Project Cost					**6,000,000**	**47,622,900**

C. INDICATIVE CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME IF AVAILABLE, ($)

Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[5]
Partners primarily with global focus in the project				
GEF Agency	Policy Support	United Nations Environment Programme (UNEP)	In-kind	2,000,000
Non-ministry government body	Science and Policy Support	UK Natural Environment Research Council (NERC), Centre for Ecology & Hydrology, UK, as host of the International Nitrogen Initiative (INI)	In-kind	3,500,000
Other Multilateral Agency (ies)	Science	Secretariat to the Convention on Biological Diversity (CBD), Canada	In-kind	TBD
Other Multilateral Agency (ies)	Policy Support	UNECE Conventions on Transboundary Water and Transboundary Air Pollution, Geneva	In-kind	50,000
Other Multilateral Agency (ies)	Science and Policy Support	IIASA - International Institute for Applied Systems Analysis, Austria	In-kind	2,100,000
Other Multilateral Agency (ies)	Science and Policy Support	European Commission Joint Research Centre (JRC), Italy	In-kind	1,500,000
Other Multilateral Agency (ies)	Science and Practices	Food and Agriculture Organization of United Nation (Animal Production and Health Division)	In-kind	900,000
Other Multilateral Agency (ies)	Science and Practices	International Fertilizer Development Center (IFDC), Alabama, USA.	In-kind	2,180,000
Other Multilateral Agency (ies)	Science	World Meteorological Organization, Global Atmospheric Watch, Geneva	In-kind	TBD
Other Multilateral Agency (ies)	Policy Support	Organisation for Economic Co-operation and Development (OECD), Paris	In-kind	100,000
Non-ministry government body	Science	National Institute for Public Health and the Environment (RIVM), The Netherlands	In-kind	1,000,000
Non-ministry government body	Science and Policy Support	Italian National Agency for New Technologies, Energy and sustainable economic development	In-kind	300,000
Non-ministry government body	Science and Policy Support	PBL Netherlands Environmental Assessment Agency, The Netherlands	In-kind	250,000

[4] To be calculated as percent of subtotal.

[5] Outline expression of interest, subject to finalization of the plans during the project preparation grant (PPG) phase. TBD = to be determined during PPG phase. NFC = non financing contributor.

Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[5]
Non-ministry government body	Science and Practices	Institut Nationale Recherche Agronomique (INRA), France	In-kind	4,000,000
Non-ministry government body	Science	National Oceanographic and Atmospheric Administration (NOAA), as a partner of the Global Atmospheric Watch, USA	In-kind	TBD
Non-ministry government body	Science	Flemish Environment Agency, Antwerp, Belgium	In-kind	2,000,000
Non-ministry government body	Science	Norwegian Meteorological Institute, Oslo, Norway.	In-kind	1,800,000
Others	Science and Policy Support	Wageningen University, Netherlands	In-kind	3,000,000
Others	Policy Support and Practices	Stockholm Environment Institute	In-kind	3,350,000
Others	Science and Policy Support	Energy research Centre of the Netherlands	In-kind	900,000
Others	Science	Woods Hole Research Center, USA	In-kind	500,000
Others	Science and Practices	University of Delaware, College of Agriculture & Natural Resources	In-kind	750,000
Others	Science and Practices	Aarhus University, Denmark	In-kind	2,000,000
Others	Science and Practices	World Resources Institute, Water Quality Team	In-kind	300,000
Others	Science and Policy Support	IVL Swedish Environmental Research Institute	In-kind	200,000
Others	Science and Practices	Environment Centre Wales, Bangor University	In-kind	52,000
Others	Science	CNRS/University Pierre et Marie Curie, Paris, France	In-kind	200,000
Others	Science and Dissemination	University of Virginia, USA		250,000
Others	Science, Practice & Dissemination	Louis Bolk Institute, Netherlands.		90,000
Private Sector / Business	Policy Interest and Practices	International Fertilizer Manufacturers Association (IFA), Paris, France	In-kind	100,000
Private Sector / Business	Policy Interest and Practices	Fertilizers Europe, Brussels, Belgium	Cash In-kind	20,000 30,000
Private Sector / Business	Science and Practices	Yara International ASA, Research Centre Hanninghof, Germany.	In-kind	100,000
Private Sector / Business	Science, Policy and Practices	PigCHAMP Pro Europa (PCH), Spain	In-kind	400,000
Private Sector / Business	Science and policy interest	International Plant Nutrition Institute (IPNI), United States.	In-kind	150,000
Private Sector / Business	Science and practices	BASF, Division of Plant Protection, Germany	In-kind	TBD
Private Sector / Business	Practices Development	CEMA aisbl – European Agricultural Machinery	In-kind	TBD
Private Sector / Business	Practices Development and Policy	Technology Innovation Platform (TIPI) of the International Federation of Organic Agriculture Movements (IFOAM)	In-kind	TBD
Private Sector / Business	Science and policy interest	MakingEnergy, USA	In-kind	TBD
Private Sector / Other	Practices Development	University of Leeds in partnership with Marks and Spencer plc (retail sector).	In-kind	TBD
Civil Society Organisation	Policy and Dissemination	World Wide Fund for Nature conservation (WWF), Godalming, UK.	In-kind	TBD
Civil Society Organisation	Policy and Dissemination	Friends of the Earth (England, Wales, and Northern Ireland).	In-kind	800,000

Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[5]
Civil Society Organisation	Policy and Dissemination	Planetary Boundary Initiative (BPI)	In-kind	200,000
Civil Society Organisation	Policy and Dissemination	Oxfam, Oxford, UK.	In-kind	TBD
Civil Society Organisation	Policy and Dissemination	Other Civil Society organizations.		
Partners primarily with regional demonstration focus in the project[6]				
CASE 1: Developing regions with excess reactive nitrogen loss				
Others	Science and Dissemination	Indian Nitrogen Group and the Society of Nature Conservation of India.	In-kind	50,000
Others	Science and Practices	Center for Sustainable Technologies, Indian Institute of Science, Bangalore	In-kind	200,000
Others	Science and Practices	Chilika Development Authority and School of Biotechnology, KIIT University	In-kind	500,000
Others	Science and Practices	Punjab Agricultural University/Indian Nitrogen Group	In-kind	20,000
Non-ministry government body	Science and Practices	Indian Agricultural Research Institute, New Delhi, India	In-kind	50,000
Others	Science, Practice and Policies Support	China Agricultural University, Beijing	In-kind	500,000
Others	Science Support	Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China	In-kind	500,000
Others	Science Support	Beijing Forestry University (BFU), Beijing, China	In-kind	300,000
Others	Science and Practices	Rothamsted Research, UK	In-kind	600,000
Others	Science and Practices	UK China Sustainable Agriculture Innovation Network (SAIN)	In-kind	TBD
Others	Science and Practices	National Institute for Agro-Environmental Sciences (NIAES), Ibaraki, Japan	In-kind	800,000
Others	Science, Practices and Policy support	Brazilian National Institute for Space Research (IPNE), Brazil	In-kind	400,000
CASE 2: Developing regions with insufficient reactive nitrogen				
Multilateral Agency (ies)	Science support	CGIAR: International Center for Tropical Agricultural, Research Program on Climate Change, Agriculture and Food Security, in cooperation with the International Livestock Research Institute (ILRI), Kenya	In-kind	2,000,000
Others	Science and Practices	Karlsruhe Institute of Technology, IMK-IFU, Germany	In-kind	150,000

[6] The final decision on which case studies to include and the balance of effort between them will be made during the PPG phase. It is expected that not all

Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[5]
Others	Science, Practices and Policies	International Institute for Tropical Agriculture (IITA), International Centre for Research on Agro-Forestry (ICRAF), Kenya, Makerere University, Uganda and Sokoine University, Tanzania.	In-kind	TBD
CASE 3: Nitrogen challenges for transition economies				
Non-ministry government body	Science and Practices	State Scientific Institution "North-West Research Institute of Agricultural Engineering and Electrification (SZNIIMESH) of the Russian Academy of Agricultural Sciences	In-kind	100,000
Non-ministry government body	Science and Practices	State Scientific Institution, All-Russian Research Institute of Organic Fertilizer and Peat of Russian Academy Agricultural Sciences	In-kind	250,000
Others	Science and Practices	All-Russian Institute for Agrochemsitry named after Dr. Priyanishnikov	In-kind	240,000
Others	Science Support	Institute of Physicochemical and biological Problems in Soil Science of RAS	In-kind	40,000
Others	Science and Practices	Water Resources Engineering Institute, Aleksandras Stulginskis University, Kaunas, Lithuania	In-kind	100,000
Others	Science and Policy Analysis	Baltic Nest Institute (BNI), Stockholm University, Sweden [partner working closely with the Helsinki Commission for the protection of the Baltic Sea]	In-kind	100,000
Government	Science and Policy Analysis	Kazakh Ecology and Climate Research Institute of the Ministry of Environment Protection of the Republic of Kazakhstan (KazNIIEK), Kazakhstan	In-kind	TBD
Others	Science and Practices	Institute of Agroecology and Environmental Management of National Academy of Agrarian Sciences of Ukraine (IAEM NAAS), Ukraine	In-kind	250,000
Others	Science and Practices	National Institute of Research and Development for Marine Geology and Geoecology, Bucharest, Romania	In-kind	400,000
Others	Black Sea Case Study	Slovak University of Agriculture in Nitra	In-kind	150,000
Non-ministry government body	Science, Practices and Policy Support	Research Institute of Agricultural Engineering, Czech Republic	Cash In-kind	50,000 100,000
Non-ministry government body	Science, Practices and Policy Support	Crop Research Institute, Czech Republic	Cash In-kind	50,000 100,000
Government	Policy Support	Ministry of Agriculture, Czech Republic	In-kind	50,000
National Government	Practice and Policy Support	Environment Agency, Austria	In-kind	10,000
CASE 4: Nitrogen challenges for developed regions with excess reactive nitrogen loss				

Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[5]
Others	Science and Practices	Technical University of Madrid / Universidad Politécnica de Madrid, Contamination of agrosystems by agricultural practices (COAPA)	In-kind	300,000
Others	Science, Practices and Policy Support	Technical University of Madrid / Universidad Politécnica de Madrid Group: Ag Systems	In-kind	250,000
Others	Science, Practices and Policy Support	Public University of Navarre/Universidad Pública de Navarra	In-kind	150,000
Others	Science, Practices and Policy Support	Research Center for Energy, Environment and Technology – CIEMAT Centro de Investigaciones Energética Ecotoxicology.	In-kind	450,000
Others	Science, Practices and Policy Support	Basque Centre For Climate Change, Spain	In-kind	100,000
Others	Science, Practices and Policy Support	University of the Basque Country, Spain	In-kind	150,000
National Government	Policy Support	Ministry of Agriculture, Food and Environment - Spain	In-kind	90,900
Others	Supporting Demonstration	University of Reading, UK	In-kind	3,000,000
Total Co-financing				**47,622,900**

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

GEF Agency	Type of Trust Fund	Focal Area	Country Name/Global	Grant Amount ($) (a)	Agency Fee ($) (b)[2]	Total ($) c=a+b
UNEP	GEFTF	International Waters	Global	6,000,000	570,000	6,570,000
(select)	(select)	(select)				0
(select)	(select)	(select)				0
(select)	(select)	(select)				0
(select)	(select)	(select)				0
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.

E. PROJECT PREPARATION GRANT (PPG)[7]

Please check on the appropriate box for PPG as needed for the project according to the GEF Project Grant:

	Amount Requested ($)	Agency Fee for PPG ($)[8]
• No PPG required.	-- 0--	--0--
• (upto) $50k for projects up to & including $1 million		
• (upto)$100k for projects up to & including $3 million		
• (upto)$150k for projects up to & including $6 million	150,000	14,250
• (upto)$200k for projects up to & including $10 million		
• (upto)$300k for projects above $10 million		

PPG AMOUNT REQUESTED BY AGENCY(IES), FOCAL AREA(S) AND COUNTRY(IES) FOR MFA AND/OR MTF PROJECT ONLY

Trust Fund	GEF Agency	Focal Area	Country Name/ Global	(in $)		
				PPG (a)	Agency Fee (b)	Total c = a + b
GEF TF	UNEP	International Waters	Global	150,000	14,250	164,250
(select)	(select)	(select)				0
(select)	(select)	(select)				0
Total PPG Amount				**150,000**	**14,250**	**164,250**

MFA: Multi-focal area projects; MTF: Multi-Trust Fund projects.

[7] On an exceptional basis, PPG amount may differ upon detailed discussion and justification with the GEFSEC.

[8] PPG fee percentage follows the percentage of the GEF Project Grant amount requested.

PART II: PROJECT JUSTIFICATION

A. PROJECT OVERVIEW:

This project addresses a critical global problem of excess reactive nitrogen in the aquatic 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 across the 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.

Recent publications (November 2013) by UNEP[9] highlighting impacts of differing agricultural approaches (specifically tilling) to the releases of N_2O from fertilisers and manures, and by WMO[10] on the contribution of reactive nitrogen on climate change emphasise the current interest and importance of the global nitrogen debate. Through this proposed project, the GEF is in a good position to both develop a better understanding of the regional and global nitrogen cycles and to assist in implementing a management system that would, through the GPA for example, work to combat the negative impacts of reactive nitrogen.

A.1.1 Global Environmental Problems

Introduction

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 essentially to global food security and have been the main driver of dramatically improved agricultural yields over the last 60 years as population has grown to over seven billion. In the same time, nutrient loads from continents to oceans and coastal zones (including deposition of N_r from atmosphere) have increased roughly three-fold, primarily from agricultural uses (including inefficient application of manure/fertilizer and animal waste) and from wastewater (including from rapidly growing cities in both developed and developing world).

Reactive nitrogen has been highlighted as one of the three 'planetary boundaries'[11] that have been exceeded as a consequence of human activities. The other two exceeded threats are climate change and biodiversity loss from a total of nine boundaries overall. The importance of the N_r is further raised by links between the carbon and nitrogen cycles and impacts on climate change[12]. 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 estimated to be exceeded[9], although concerns about global P resource depletion add another dimension to its current pollution impacts at local and regional scales.

By selecting to focus on N_r, leading to the development of the International Nitrogen Management System (INMS), this proposal acknowledges the importance in both the benefits and the problems of

[9] The Emissions Gap Report 2013 - UNEP (November 2013), http://www.unep.org/publications/ebooks/emissionsgapreport2013/portals/50188/EmissionsGapReport%202013_high-res.pdf

[10] 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

[11] 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/

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

nutrient 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 nitrogen oxides (NO_x) emissions to the atmosphere. The prime focus of the project on N_r allows it to address the cross-cutting impacts of reactive nitrogen on health, climate change, land management, biodiversity, greenhouse gas emissions, pollution, etc., and to identify links with other nutrient cycles for consideration in the future. These other biogeochemical links include carbon, phosphorus, sulphur, and micronutrients. In developing 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.

Key impacts from excess reactive nitrogen include:

- **Water Quality:** Excess nutrients (including N and P) 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 2001 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:** – with 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** – including emissions of N_2O plus interactions with other N_r forms, carbon, particulate matter and atmospheric N deposition, plus tropospheric O_3. 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** – including the loss of species of high conservation value naturally maladapted to high levels of N_r, so that deposition threatens the biodiversity of many 'protected' natural ecosystems.

Key impacts from insufficient reactive nitrogen include:

- **Food insecurity** – Inadequate N_r (and other components of fertilizer) leading to insufficient food production in developing regions of the world - specifically sub-Saharan Africa.
- **Soil quality** – over-fertilization and excess atmospheric N_r deposition acidify natural and agricultural soils, while a shortage of nutrients (mainly N_r and P) leads to soil degradation (nutrient depletion of the soil), which can be exacerbated by a shortage of micronutrients, leading to loss of fertility and erosion.

Reactive nitrogen is present in both natural and man-made forms in all the Earth's compartments (atmosphere, hydrosphere, lithosphere and biosphere). The global concern is on how man-made forms and quantities are perturbing the overall nitrogen cycle and the impacts on the environment and human well-being.

The main anthropogenic sources of new N_r production are fertilizer manufacture (120 Mt/yr nitrogen[14]), crop biological nitrogen fixation (60 Mt/yr) and fossil fuel combustion (40 Mt/yr). As these inputs are utilised by the biosphere, losses contribute to significant N_r pollution of the environment:

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

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

- **Fertilizers in agriculture:** In order to feed the world's population approximately 2% of the global energy production is used in the production of reactive nitrogen, 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 crops and the remaining over 75% being lost to the global environment.
- **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.
- **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, with current technologies based on denitrification (conversion back to N_2) rather than as N_r capture and targeted use. These emissions (40 Mt/yr) can 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) (42 Mt/yr) from agriculture combine with NO_x to increase rates of N_r deposition to natural ecosystems, disturbing ecosystem function.
- **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.

The increasing population will further necessitate the use of chemical fertilizers (and better use of manures) in regions with low agriculture production and limited low nitrogen availability. At the same time, the developing middle classes (increasing per capita consumption) and urbanization are increasing urban N_r pollution, both to air and in wastewaters. These changes will further increase the threats of N_r pollution, if appropriate management practices are not adopted, and increase the likelihood of new areas with coastal hypoxia unless more effective nitrogen management practices are developed.

Current Scientific Understanding of Global Nitrogen Cycle

Scientific efforts over the last decade have substantially increased our understanding on different parts of the nitrogen cycle. Process understanding has advanced substantially, 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.

At the regional scale, the European Nitrogen Assessment[15] 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. In addition, it appears that climate warming will substantially increase NH_3 emissions, but the

[15] Sutton et al., 2011, *European Nitrogen Assessment.* Cambridge University Press

climate relationships are not included in global models[16]. 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.

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 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 Nitrogen Assessment[17], 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[18], 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*"[19], prepared jointly by the Global Partnership on Nutrient Management (GPNM) and the INI.

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. 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).

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.

[16] *The Global Nitrogen Cycle in the 21st century*; Fowler, Sutton et al. 2013, Special Issue of *Philosophical Transactions of the Royal Society*

[17] Suddick, E.C. et al., 2013 Biogeochemistry 114, 1 *The role of nitrogen in climate change and the impacts of nitrogen - climate interactions in the United States: forward to thematic issue*

[18] Austin et al. 2013, Science, 340, 149. *Latin America's nitrogen challenge*

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

Gaps in Knowledge, Barriers to Change and Scientific Support for the Global Nitrogen Cycle

Our Nutrient World identified key policy barriers to the challenges of global nitrogen management in acknowledging that current policies are inadequate from the local to the global scale. Specifically the report highlighted the following overarching policy challenges:

- There is currently no international treaty that links nutrient (including N_r) benefits and threats. Guidance through an international process would help in implementing sound nutrient policies targeted to global and region-specific objectives. The 'barriers to change' are often supra-national in scale and also necessitate a global approach, including the global scale of trade in fertilizers and agricultural products, which can constrain the adoption of nutrient best practices.
- National and international policies are required to encourage good nutrient management. Until now, policies have been specific to different nutrient 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.
- Existing N_r policies 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 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)[20].

All these issues are drawn together in what may be termed 'The Nutrient Nexus', where good nutrient management can be seen as a central foundation for future food and energy security, while addressing multiple global change challenges, for environment, climate and health.

Specifically *Our Nutrient World* called for international consensus as the basis to:

- Establish a global assessment process for nitrogen, phosphorus and other nutrient interactions, 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,
- Develop consensus on the operational indicators, with benchmarking to record progress on improving nutrient use efficiency and reducing the adverse environmental impacts,
- Investigate options for improvement of nutrient use efficiency, demonstrating benefits for health, environment, and the supply of food and energy,
- Address barriers to change, fostering education, multi-stakeholder discourse and public awareness,
- Establish internationally agreed targets for improved N_r and P management at regional and planetary scales,
- Quantify the multiple benefits of meeting the nutrient management targets for marine, fresh-water and terrestrial ecosystems, mitigation of greenhouse gases and other climate threats, and improvement of human health,
- Develop and implement an approach for monitoring time-bound achievement of the nutrient management targets, and for sharing and diffusing new technologies and practices that would help to achieve the targets.

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

Following the launch of *Our Nutrient World*, feedback discussion of these challenges with stakeholders has identified the merit of distinguishing three complementary tracks in the overall response strategy:

Track 1: International Policy Development for Nitrogen*:* It remains an open question for governments which existing international policy framework will take the lead on nitrogen. As a starter for discussion, Chapter 8 of *Our Nutrient World* identified the option to strengthen and extend the 'Global Programme of Action for the protection of the marine environment from land-based activities' (GPA) as a potential lead body (for further details see section A.1.2). Other options also need to be considered, for example by the United Nations Environment Assembly.

Track 2: Scientific Support for Nitrogen Policy Development: While it remains and open question which multilateral policy framework will take the global lead on N_r, there is the need to provide scientific underpinning to support decision makers in developing sound agreements. This must 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: Public engagement about the nitrogen threats and opportunities: Without significant public engagement little substantive progress can be expected in the cycle between policy making and scientific support. The key actors benefiting from N_r use and contributing to N_r pollution will have insufficient information on how to improve, while governments will not be empowered to take action by their citizens. It is therefore vital that nitrogen scientists focus on developing clear public messages from their research and actively engage with industry, business, media and civil society on the threats and the opportunities arising from better nitrogen management.

In practice, progress in the three tracks will feed-back on each other. The development of scientific evidence, understanding of barriers, and the quantification of benefits from improved N_r management under Track 2, will help focus the challenges to be addressed under Tracks 1 and 3. At the same time, effective action under Track 3 will help to crystallize action under Track 1, while refining the research priorities of Track 2. Better public awareness can be expected to bring substantial financial benefits by fostering innovation in the 'green nitrogen economy' (e.g. increased investment with improved products), while delivering substantial health, ecosystem and social benefits through improved food, energy, environmental and climate security. By involving all sectors (and the many different views) from the outset, a much stronger basis to support decision making can be expected.

While many regional Conventions provide expertise relevant for delivering parts of Track 2 (e.g. mature systems of scientific support in the CLRTAP, HELCOM etc), this is currently missing in regards to global scientific analysis of the nitrogen cycle. In developing and demonstrating an *International Nitrogen Management System* (INMS), the present proposal therefore allows GEF to act catalytically in bringing together the key players to establish this scientific support process (Track 2). At the same time, by cooperating between scientists, governments, business and civil society, a much stronger basis for public engagement will be developed (Track 3). The combination of technical advances and improved public understanding made in this project would thereby feed in to support GPA and other international processes for Track 1. (e.g. Convention on Biological Diversity (CBD), Framework Convention on Climate Change (UNFCCC), Montreal Protocol (relevant for N_2O) and the regional water and marine agreements).

A Programme for Change

These points highlight the need to develop effective practices for global nitrogen management. A major barrier until now has been the general focus on nutrient issues under separate policy domains. Building on the recommendations of *Our Nutrient World*, this proposal recognizes that counting the multiple benefits of improved nitrogen management can be expected to deliver a much stronger gravity enabling transformational change to improve the protection of international waters from nitrogen pollution. Building on the on-going stakeholder dialogue from the International Nitrogen Initiative (INI) and the Global Partnership on Nutrient Management (GPNM), it is expected to centre the overall effort on: a) building approaches to improve full-chain nitrogen use efficiency; b) developing tools to allow quantification of the multiple co-benefits of better N_r management; c) investigating options for improved practices through regional case studies; and d) demonstrating the chain of scientific evidence in the form of the International Nitrogen Management System (INMS) to provide essential support to, *inter alia,* GPA and linked policy processes.

The need for improved understanding of the global and regional nitrogen cycles is essential if clear management strategies and guidance are to be introduced to assist regions where there is both excess and insufficient reactive nitrogen – the consequences of both situations having a negative impact on global food security and environmental quality. In the context of current policies for renewable energy targets, increased use of high production biofuels (such as ethanol from corn and bio-diesel) will require even large inputs of nitrogen fertilizer.

This demonstrates the need to develop and analyze future scenarios of both global and regional nitrogen use, as *a basis for delivering the evidence necessary to show how management of nitrogen in support of IW objectives (specifically,* objective 3: '*to support foundational capacity building, portfolio learning, and targeted research needs for ecosystem-based, joint management of transboundary waters'), will simultaneously deliver quantified benefits in relation to food security, energy security and other environmental threats*. Drawing together the evidence, making the links and demonstrating the effects of management decisions will enable GPA and others to develop well-informed transformational policy actions for protection of our global commons at global, regional, national and local scales.

The nitrogen cycle operates across multiple spatial scales, from the dynamics of a single field, through transboundary transport of air and water pollution, to the global increase in N_2O concentrations. Such interconnections require consensus on an international approach under Track 1 that takes account of local and regional conditions, while addressing the necessary improvement in nutrient use efficiency at the global scale. The role of 'barriers to change' also necessitates a global approach. These include the global scale of trade in fertilizers, food crops, animal feed, energy and live-stock products, which can constrain the adoption of best management practices relative to nutrient application and retention. Major differences exist between those parts of the world that produce and use most of the nutrients and those that do not have enough. The key regions where most nutrients are used include North America, Europe, and parts of South and South East Asia and South America. By contrast, many parts of Africa and South America have insufficient access to nutrients, leading to soil nutrient depletion limiting productivity.

The last decades have seen a significant increase in both the awareness of the issues of excess nitrogen and its impacts in coastal waters and the problems of insufficient nitrogen in regions where food security is a significant concern. To-date there has been little attention paid to understanding the full nitrogen cycle and encouraging the use of reactive nitrogen (and nutrients in general) in efficient ways. This project will develop the understanding of the nitrogen cycle, recommend approaches for regional and global management (through international bodies such as the GPA) and develop tools and evaluation methods to governments to assist with local/national policy development.

The *consequences of taking no action* include further climate related impacts due to atmospheric warming by N_2O, deterioration of water, air and soil quality impacting human health, ecosystem services and biodiversity. The full cost of impacts has yet to be assessed, but global losses of ecosystem services from fisheries from excess nutrients is estimated at $ 200 billion annually[21]. Globally, a target to achieve a relative improvement in full-chain nutrient use efficiency by 20% would deliver an estimated saving of 20 million tonnes reactive nitrogen. Based on European estimates[22], this would equate to an improvement in human health, climate and biodiversity of the order of $160 billion per year[23].

A.1.2 Baseline Scenario and Projects

Continuing to use and release reactive nitrogen into the environment will add to coastal hypoxic zones and have detrimental impacts on health and quality of life from excess nitrogen in 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[24]. In addition, regions that have insufficient nutrients leading to concerns on food security need to develop and implement appropriate policies and practices to effectively manage N_r prior to the introduction of modern fertilizers to prevent potential future problems from excess N_r.

This substantial worsening according to business as usual results from a combination of both increasing global population and per capita consumption rates (of food and energy). It is therefore vital that a pathway is developed into future policy making to take account of the scientific evidence, recognizing the multiple benefits of taking action.

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.

Relevant baseline programmes and initiatives include:

The Global Programme 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 programmes 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 programmes 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"[25].

[21] Diaz, R.J., H.E. Hägg, and R. Rosenberg. 2013. Hypoxia. In: K.J. Noone, U.R. Sumaila, and R.J. Diaz (eds.), Managing ocean environments in a changing climate. Elsevier, New York.
[22] Sutton et al. 2011. *European Nitrogen Assessment*
[23] Sutton, M.A., et al. 2013. *Our Nutrient World: The challenge to produce more food and energy with less pollution.*
[24] Sutton and Bleeker, 2013, Nature 459, 435. *Environmental Science: The shape of nitrogen to come*
[25] Manila Declaration: GPA IGR-3

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 Programme (IGBP) 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) and Edinburgh (2011) 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 current simple nitrogen indicator under the Aichi Process for the CBD.

The INI operates through regional centres which have been developing regional nitrogen assessments, including the recent European Nitrogen Assessment[26], 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 Nitrogen Assessment[27], has contributed to the US National Climate Assessment. Regional assessments for Africa, South and East Asia are currently being developed, and together provide a basis to help mobilize the international community in support of the GEF objectives. 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 framework that addresses the cross-cutting nature of the global nitrogen cycle. 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.

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.

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 (Track 2), which is currently missing from GPA and other international policy frameworks (Track 1) and further engagement of the public (Track 3) in the key debates.

[26] Sutton et al. European Nitrogen Assessment;

[27] Suddick, E.C. et al., 2013 Biogeochemistry 114, 1 *The role of nitrogen in climate change and the impacts of nitrogen - climate interactions in the United States: forward to thematic issue*

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 (summarised in the STAP 2011 report[28]), 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[29] that will be further built upon with this proposed project. The problems of insufficient reactive nitrogen 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), the International Plant Nutrition Institute (IPNI), and the Millennium Villages project supported by the Gates Foundation. In order to ensure balance, groups with interest in both conventional and organic farming methods are included.

The **GEF is currently funding the UNEP *'Global Foundations for reducing nutrient enrichment and oxygen depletion from land-based pollution in support of the global nutrient cycle'* (Global Nutrient Foundations, or GNF)** 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 GNF project is "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".

The present achievement of the GNF 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 for future modelling analysis 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.
- An established global partnership on nutrient management to provide a necessary stimulus and framework for the effective development, replication, up-scaling and sharing of these key outcomes.

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

[29] 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 summary of the status and main outputs of the GEF/UNEP Global Nutrient Foundations project is provided at Annex 4.

Task Force on Reactive Nitrogen (TFRN)

The 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 current GEF proposal. The TFRN was established in 2007 by the Executive Body of the CLRTAP with 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, that counts the multiple co-benefits of taking action. The TFRN has thus developed guidance documents on NH_3 abatement and on national nitrogen budget approaches (now adopted by the convention), as well as examining the relationship between nitrogen and climate, nitrogen and food, and most recently (also in contribution to the development of this GEF proposal) the links between nitrogen in the CLRTAP and the UNECE Transboundary Water Convention (Water, Food, Energy, Ecosystems nexus).

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 programmes). 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)[30]. In addition, through the ENA, the TFRN has been critical in developing the thinking for counting the multiple benefits of improved N use[31]. It should be noted how the TFRN has benefited from and fed into the mature science policy support process (Track 2) of the CLRTAP[32]. This adds significantly to the baseline from which the INMS can learn as it feeds in to support GPA and other policy processes (Track 1). 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 under Track 3.

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), 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.
- **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

[30] Sutton et al., 2011, CUP
[31] Sutton et al., *Nature* 2011, 472 159. Too much of a good thing
[32] Reis S. et al. 2012, Science 338, 1154. From Acid Rain to Climate Change

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*.

- **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.
- **Food and Agriculture Organization (FAO) of the United Nations**, has recently established its Agenda for Action on livestock management practices, which together with its long term expertise on crop and livestock systems, will contribute significantly to the project baseline.
- **International Plant Nutrition Institute** (IPNI), the **Consultative Group on International Agricultural Research (CGIAR)** and the **International Fertilizer Development Centre (IFDC)** are international organizations focused on improving agricultural performance, with 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**), as well as other industry and agricultural business groups (e.g. **COPA-COGECA** the European Farmers Union, and the **International Federation of Organic Agricultural Movements, IFOAM**).
- 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 (Track 3) to be further developed.

The partners of the present 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 Annex 3.

Conclusions on the project baseline

The **baseline** for the proposed project is therefore strong, but to-date existing efforts have largely focused on the regional scale (e.g. regional water and air conventions). Despite the many efforts to reduce reactive nitrogen releases undertaken by GEF and others, there is insufficient understanding of the global N cycle and how this cycle interacts at the regional/national levels. In particular, the understanding and the links between encouraging efficient use of reactive nitrogen to assist in essential food production while minimising the impacts of excess nitrogen in receiving waters needs to be strengthened, through the development of specific nitrogen cycle tools and management approaches. The foundation is therefore well set to show how an understanding of global and regional nitrogen cycles can provide the basis to develop a system that would lead to more informed nitrogen management policies and practices.

While noting these activities, at present there is still no intergovernmental process that currently addresses the global nitrogen challenge to link the multiple benefits of better nitrogen management. Recognizing the potential for actions to build on the work of the GPA and GPNM, including the GPA Manila Declaration (adopted by governments during the GPA IGR-3, 2012), there is therefore a key opportunity through the present project to develop the International Nitrogen Management System (INMS) to underpin future intergovernmental decision-making with a robust and well-coordinated scientific support process. These complementary activities can be distinguished as Track 1 (the nitrogen policy process) and Track 2 (the scientific support process for nitrogen policy development). As

governments develop the discussion of how Track 1 will be delivered globally, the present project developing the INMS will allow Track 2 to demonstrate the actions needed and deliver the necessary policy support. In parallel, the project will provide a contribution to developing public engagement (Track 3), by involving business and civil society groups from the outset and by including specific elements to support training, diffusion of knowledge and public understanding.

As international discussions under Track 1 progress, the INMS will provide the essential scientific and technical support on nitrogen management to underpin policy decisions, irrespective of the eventual policy structures.

A.1.3 Alternative Scenario and Component Details

The approach adopted by this project is to understand the full nitrogen cycle, thereby addressing issues of insufficient (as relevant to food security and land degradation) and excess (resulting in, for example, coastal eutrophication, air pollution and climate balance) Nr. The project will utilise the experiences and knowledge gained from over 20 years of nutrient reduction activities and develop appropriate tools to convert this knowledge into policy recommendations and management actions relevant for all key sectors (e.g., agriculture, transport, industry, waste-water and citizens' choices). By engaging local, national, regional and global policy makers and other key stakeholders through the development and application of the proposed tools to provide management information, and the demonstration of these tools in selected pilots, this project will further build functional linkages between the science and policy communities. This greater understanding and co-operation between science and policy will deliver benefits to addressing issues of concern related to biodiversity, sustainable land management, reducing greenhouse gas emissions and pollution control, while simultaneously being of benefit to addressing food security and human health.

A two-way interaction between the regional pilot/demonstration activities and the global analysis of the nitrogen cycle by the project are envisaged. The pilot activities will be selected to build on existing or planned nitrogen management activities to enable the limited resources available to be used effectively and to ensure that the GEF resources are catalytically employed. Firstly, the global analysis will support the regional demonstration by provision of regional modelling estimates, that quantify elements of the nitrogen cycle, extent of benefits and threats in comparison with other areas globally. This will support the regional demonstration activities in their work to highlight and address key challenges as these differ locally according to conditions. Critically, this will also inform the development of regionally specific 'nitrogen management plans', that take account of local priorities and consider the most cost effective contributions to improved N management for different outcomes, while looking for synergies (e.g. reduced N pollution losses, with improved nitrogen use efficiency simultaneously contribution to food security). In return, the regional studies are critical in feeding back into the global analysis. This includes the provision of regionally specific local data to improve global models, including impact assessment, prioritization of management options, and parameters on these options, which need to be addressed within the global modelling framework, and assessment of the economics and barriers to change that must be addressed if substantive progress is to be made.

It should be emphasized that the intention is not simply to pilot a few new management measures, rather, the aim is to draw upon examples of best practices, while identifying new approaches, that can form the basis for developing coherent, regionally specific nitrogen management strategies, which take

account of the multiple benefits and threats within the context of the overall nitrogen cycle. This local specificity is thus critical in feeding in robustness, credibility and realism into development of the global INMS approach.

Given the wide range of different users of the project, it is useful to summarize the main deliverables of the project in relation to the key user needs (see Figure 1). Further details of the relationship of the INMS activities in relation to the policy development and implementation process are illustrated in Figure 2 in Annex 1.

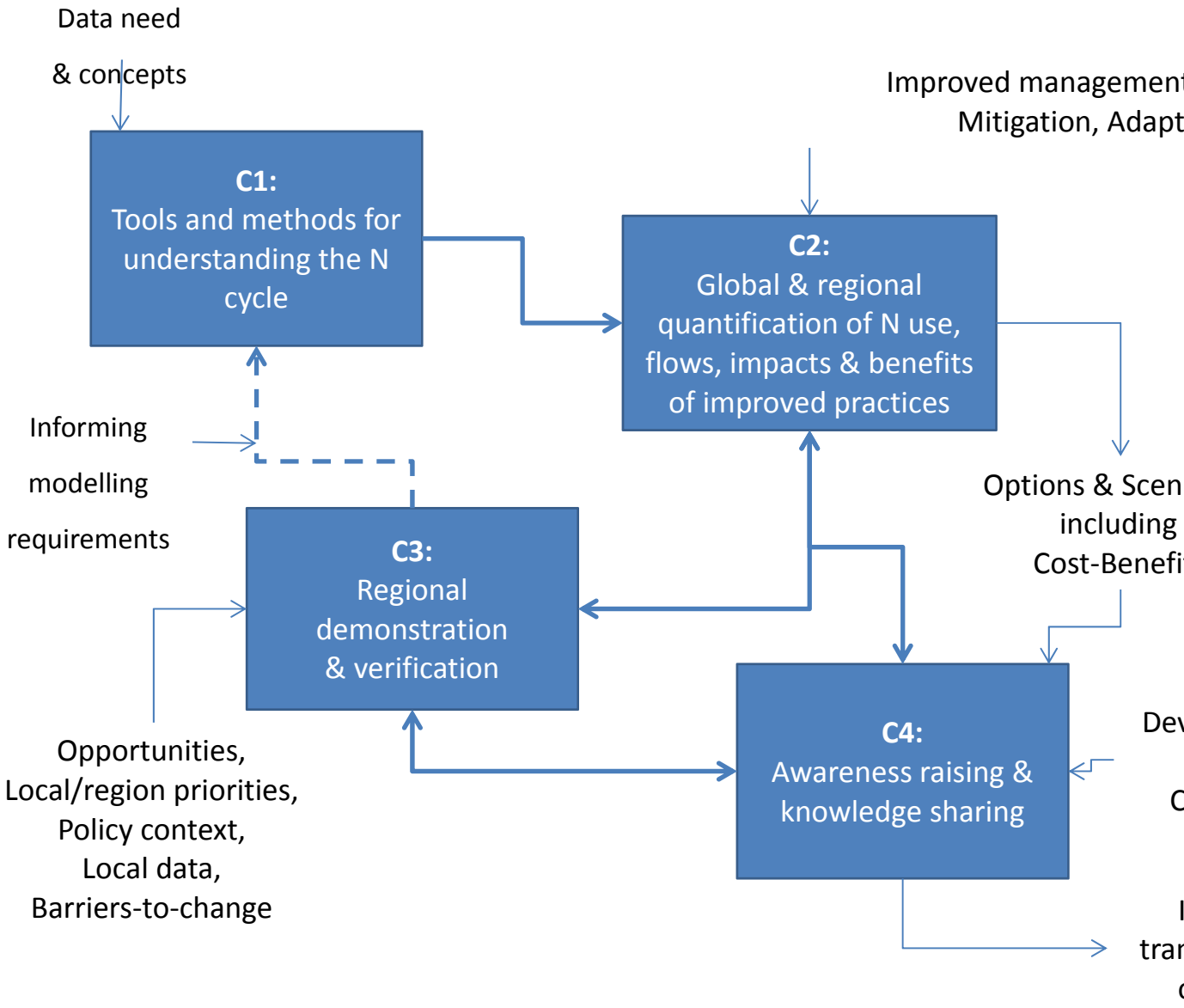


Figure 1. Summary of the main components of the Global Nitrogen Cycle project toward establishment of the International Nitrogen Management System (INMS)

Summary of Project Components

The Project will build on previous GEF interventions related to understanding nutrients such as nitrogen and phosphorus in a global perspective (e.g. Global Nutrient Foundations) and will further strengthen the science-to-policy linkages that will aid the development of an agreed global nitrogen management strategy. 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 intergovernmental decision-making, taking account of the multiple benefits of improved nitrogen management. The project will develop a system that shows how actions to protect the marine environment from land based sources of nitrogen pollution will simultaneously have quantified 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.

In addressing the recommendations identified in the STAP report: *'Hypoxia and nutrient reduction in the coastal zone'*, the proposed project will develop approaches to implement global management of reactive nitrogen. The STAP proposed four key areas of research: 1) Synthesize existing information on causes and consequences of excess N_r to coastal ecosystems; 2) Conduct focused actions and research in three to five locations; 3) Identify future eutrophication and hypoxia hotspots using trend and future scenarios, and, 4) Move towards an ecosystem-based management approach. The proposed INMS project responds to all four of these GEF STAP recommendations addressing the problems associated with reactive nitrogen.

This proposed project acknowledges that reactive nitrogen is one of several key nutrients of environmental concern, while being essential for global food and energy security. The proposed project focuses on reactive nitrogen due to the many cross-cutting interactions of reactive nitrogen (water, air, climate change, health, biodiversity, food and energy security). It is also recognised that it will be necessary to consider the links with other nutrient cycles (phosphorus, carbon, sulphur, etc.) as key interactions apply in different contexts (for example the close linkage between N and P in assessing eutrophication risks).

The International Nitrogen Management System (INMS) targeted research project is designed to be implemented through four technical inter-linked components supported by a project management activity.

Box 1: Summary of how the proposed project builds on the Global Nutrient Foundations project.

While the focus of the existing GEF *Global Nutrient Foundations* (GNF) project is on nutrients in coastal zones, it provides an important baseline in preparing for the next stage of global development to be achieved through the new project on the global nitrogen cycle. The new project will contribute to inform parallel developments in *global and regional policies for nitrogen* (denoted Track 1), while the scope of the project work is as a *research and demonstration effort* (denoted Track 2), while contributing to public engagement (Track 3).

The key new aspects of the present proposal include:

- Global analysis on the nitrogen cycle that quantifies the links between coastal zone eutrophication and other threats in the global nitrogen cycle, in relation to assessment of the major societal benefits of nitrogen use. (Project builds on the mainly coastal focus of GNF)
- The development and harmonization of different nitrogen indicators, representing environmental, production and efficiency aspects, together with the benchmarking of these

indicators to allow the development of a suitable indicator package to support policy processes. (A new theme not currently a focus of GNF)

- Development of global integrated assessment modelling, and cost-benefit analysis (CBA) that links the multiple benefits and threats of nitrogen, building gravity for the protection of International Waters (relevant for GPA), while making a quantified contribution to other international agreements (water, air, climate, food, energy, health etc). (Develops the global biogeochemical modelling of GNF, extending this to multi-issue interactions and integrated analysis, including CBA.
- Developing the International Nitrogen Management System (INMS) as a coordinated scientific support process (Track 2) to support policy development by GPA and others (Track 1), through the provision of scenarios, indicators, cost-benefit analysis, response to emerging questions etc. (A major step forward, building on the baseline networking of the Global Partnership on Nutrient Management, which has been a core achievement of GNF).
- Sharing of best practices and diffusion of technologies (Track 3), for overall management of the nitrogen cycle in order to achieve multiple societal benefits, including engagement with civil society. (Builds on and extends the options investigated by GNF, including development of new focus on technology diffusion).
- Testing and demonstration of the best practices through regional case studies in different world regions, including areas with excess reactive nitrogen, areas with insufficient and regions with transition economies. The demonstration activities will support a global analysis of the main barriers-to-change, building critical mass to foster improved management of the global nitrogen cycle. (The regional demonstration builds the necessary global perspective, going substantially beyond the two site-based demonstrations of GNF, while developing the 'gravity of common cause' through focus on improving nitrogen use efficiency, assessment of net benefits and addressing barriers). The demonstrations would not be initiated by this project but would build on existing and/or planned nitrogen/nutrient management projects. This would ensure that the limited funds available are used catalytically and assist with testing the concepts and tools developed here in 'real world' situations.

This brief summary highlights how the present INMS proposal benefits significantly from the GNF project, while developing the scientific and operational basis to go to the next stage in management of the global nitrogen cycle.

Component 1: Tools to apply methods for understanding the global nitrogen cycle

Considerable work has been undertaken by the GEF and others to develop methods for undertaking nitrogen (and nutrient) assessments, and this project will build on these previous activities developing tools to apply these methods in different regions. In particular the work of the GPA, GPNM and the European Nitrogen Assessment will provide concrete input to this project for adaptation to provide usable tools for national, regional and global assessments of the nitrogen cycle. A key task here will be harmonization of methodologies between regions and environmental compartments. Targeted research will also be directed towards providing management tools that will enable users to better address the issues of excess and insufficient reactive nitrogen. These targeted research programmes will include:

- 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 land/water;
- 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.

(This component responds to STAP Need 1: *Synthesising existing information*).

Component 2: Global / Regional quantification of nitrogen use, flows and impacts
Targeted research will be undertaken to better understand and to quantify the use, fluxes and impacts of excess and insufficient reactive nitrogen to inform regional and global management. STAP identified[33] that, with the exception of China, South Africa, Mexico and Chile, there is little research in developing countries on hypoxia, and consequently this project will prioritise the strengthening of capacity and expertise through joint research undertakings with selected developing countries. Throughout the process of strengthening research capacity, close contact will be encouraged between the science community and the policy developers to improve awareness of these roles, fostering improved data exchange between key private sector organizations , governments and researchers (e.g. fertilizer statistics, agricultural practices, waste water management statistics etc).

Research will focus on the following issues to provide a global / regional quantification of nitrogen use, flows and impacts:

- Assessment of global / regional nitrogen to assist with identification of regions with insufficient reactive nitrogen. Addressing the needs of food security in developing countries and, through this identification, assisting with implementing policies and procedures for future good management practices (Component 3) to ensure that excess nitrogen is not applied in agriculture, while maximizing the reuse of all available N_r sources.
- Quantifying global and regional impacts of excess nutrients and developing tools that can be widely applied to utilise existing nutrient source/pathway models to assist with addressing critical sources of nitrogen;
- Development of scenarios (based on a pragmatic selection of a 2013 baseline and with a horizon of 10 – 50 years) for estimating potential nitrogen loads and demands. This will assist with the identification of future hotspots if nitrogen application in depleted regions proceeds without adequate management policies and practices in-place;
- Evaluating the potential impact of climate change on and from excess and insufficient nitrogen;
- Recommendations on measures for minimising impacts from excess nitrogen and the application of nutrient use efficiency practices to optimise nitrogen management to strengthen support for food and energy security (including all sources of N_r);
- Compendium summarizing the state of knowledge, experience and measures adopted that GEF (and others) have gained from addressing the issues of excess and insufficient N_r.

(This component responds to STAP Need 2: Conduct focused action and research in three to five locations, and Need 3: *Identify future hypoxia hotspots using trends and future scenarios*).

Component 3: Demonstration and verification of management tools at the local / national levels
National/local demonstration activities will be undertaken as 'proof of concept' to verify the approaches and tools agreed for understanding and managing the impacts of insufficient and excess reactive

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

nitrogen to evaluate the tools developed for regional quantification of nitrogen. This will enable the approaches to be refined if necessary and to further strengthen the capacity to undertake additional research together with improving the national/local science – policy interface. The validated approaches for both quantification assessments and the management practices will be disseminated widely to assist with replication that will assist with ecosystem management approaches being adopted. These demonstrations will work with on-going (and planned) nitrogen management programmes (addressing insufficient and excess N_r) involving key researchers, policy makers and other stakeholders. By linking with existing (or planned) projects engaged in N_r management will assist in ensuring that the limited resources available for this activity can have the maximum, and catalytic, impact.

The project design for demonstration and verification will build on the following strategy:

- Demonstration activities that will be undertaken in different regions (for example, Latin America and the Caribbean, Sub-Saharan Africa, Eastern Europe, Central Asia, South and South East Asia[34] and in Small Island Developing States) to illustrate the benefits of the management tools identified.
- Final selection of the locations and specific activities for the demonstration activities will be developed and agreed with project partners and other stakeholders under the project preparation grant stage and will involve extensive consultation with nitrogen programmes that are underway, national science communities, national policy makers and the private sector.
- Subject to refinements at the project preparation grant stage, the proposed partnership has been built up to allow the comparison between 4 major demonstration conditions:
- 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.
- Among these situations, the priority for GEF demonstration support under this project is for Cases 1, 2 and 3. In addition, national co-financing activities are expected to allow inclusion of case studies for **developed countries**, which are important to build up the global picture, including the sharing of new technologies and best practices.

The proposed selection of the demonstration locations for these cases follows the following rationale:

- Ensure that the group of case studies is representative of the key nitrogen challenges faced by different regions across the globe.
- Contribute to developing global critical mass in the sharing of concerns, information, opportunities and solutions.
- Include demonstration of the situation with excess reactive nitrogen (including the multiple problems of pollution from the main sources (agriculture, industry, transport, sewage etc), with threats to water, air, climate, health etc, and the benefits for food and energy security of improved N management).
- Include demonstration of the situation with insufficient reactive nitrogen (including current food and energy security problems, threats to soil quality and land use change, and managing the risk of emerging pollution problems in connection with meeting future food security needs).

[34] Selection from co-operating partners, including: East Baltic , Neva (RU), Western Mediterranean, Tajo (ES), Eastern Europe (SK, CZ, UA, RO), Central Asia, Syr Darya (KZ), North China Plain, Central Africa, Lake Victoria (KN), South Asia (IN, BA).

- Include demonstration in regions with transition economies (especially Eastern Europe, Caucasus and Central Asia, EECCA), addressing the challenges of improving N supply and food security, while minimizing pollution levels.
- Complement existing local coastal demonstration activities established by the GNF project at Manila Bay and Lake Chillika with demonstration activities representative of wide regions and multiple N challenges (water, air, greenhouse, ecosystems, soils).
- If possible, provide a basic link with demonstration under the planned Water-Food-Energy-Ecosystem Nexus Assessment of the UNECE Water Convention, and detailed link for 1 or 2 catchments ensuring synergy between the efforts.
- Inclusion of demonstration in both data-rich and data-poor areas, and where current datasets are questioned, identifying the common and specific challenges of each region.

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)[35].
- To identify the main options (across N_r 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.

The intention is to prioritize a short list of demonstration areas, with the ultimate selection being made during the PPG phase taking on board the different priorities of GEF and the project stakeholders as well as regional competence and baseline. The selection of candidate demonstration areas has been made on the basis of several criteria, which specifically include the requirement to build synergy with ongoing and planned nitrogen management programmes. Other key criteria include: i) clear definition of the regional nitrogen challenge (according to the four categories listed, e.g. too much nitrogen, too little, developing country, transition economy), ii) clear regional representativity of key areas within the global context in order to build global consensus of the benefits of a common approach, while recognizing regional differences.

Within this context, and subject to agreement at PPG phase, we propose that the project will include a combination of "**core demonstration studies**" reflecting the different demonstration categories e.g.:

- *Developing region/ too much nitrogen:* North China Plain: North India/Bangladesh, (Building on ongoing National and INI initiatives, including bilateral activity. e.g. SAIN) Key issues: over-use of nitrogen and need for improved practices in agriculture that link food security benefits with water, soil air pollution, climate and biodiversity, including protection of the coastal zone from hypoxia, with the linking up of management solutions.
- *Developing region / too little nitrogen:* Lake Victoria basin, (Building on ongoing GEF and CGIAR programmes) Key issues: contrast between small holder and larger farmers with unequal and often insufficient N supply; opportunities for increased fertilizer access addressing interactions of food security and growing pollution problems, linking agriculture and sewage sources of

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

pollution, with multiple threats (e.g. water pollution in interaction with greenhouse gas pollution and atmospheric pollution).

- *Transition economy:* Eastern Europe catchment(s). (Building on TFRN Expert Panel on Nitrogen in EECCA countries and UNECE Nexus Assessment). Key issues: contrast between large collective farm and smallholder farmers, addressing the relative contribution of livestock, arable and point N sources to nitrogen pollution, linking especially water and air pollution. Addressing the suitability, potential, economics and barriers to adoption of solutions relevant for the EECCA situation, and their relation with other regions.

Demonstration regions

Considering the rationale on selection explained above, and pending final decisions during the project preparation phase, the following locations have been selected for demonstration of the four demonstration conditions:

Case 1: Regions with excess reactive nitrogen loss.

- **North China Plain - China** This represents a key region with globally the highest N_r fertilizer input rates in the world (leading to major losses and opportunities for manure and sewage N_r management), combined with intense rates of nitrogen oxides emissions from fossil fuel combustion. One of the challenges in this region is to find improved ways to recognize the value of N_r and improved crop management, given the high level of N_r subsidies. Very high levels of nitrogen oxides emissions are increasing at an even faster rate than agricultural N_r inputs, and work is required to relate the impacts of these different sources.
- **South Asia – India / Bangladesh** This region includes areas with both excess and insufficient N_r, with major pollution problems occurring. Since the Lake Chillika case study of the GEF GNF project already provides a local example of developing good practices in a N_r -limited context, the focus of the present effort will complement this by addressing particularly the challenges of excess N_r at a regional scale. The baseline evidence indicates that there is much to learn by comparing agricultural practices and support policies in neighbouring countries, with different subsidy systems. In particular, in Bangladesh a major programme rolling out the use of Urea Deep Placement (UDP) as a low emission approach is yielding benefits for reduced pollution (40% decrease in N_r losses) and increased yield by as much as 20%,[36] but there are barriers to consider why this approach has not yet been sufficiently developed in India.

Case 2: Regions with insufficient reactive nitrogen.

- **Lake Victoria – Kenya / Uganda** This developing partnership focuses on making the links between approaches to farm management to increase food production, including the opportunities and constraints in obtaining additional nitrogen sources from fertilizers, biological nitrogen fixation and improved recycling of manure and sewage N_r sources, while finding approaches that simultaneously avoid an increase in water pollution, air pollution and greenhouse gas emissions. Develops the partnership between the CGIAR (ILRI - International Livestock Research Institute), with local university partners, stakeholders and other partners involved in the Millennium Villages project, while building on previous GEF interventions.
- **Latin America –** it is anticipated that the project will extend its demonstration to Latin America and the Caribbean, though offers from this region have not yet been received. Networking during the GLOC-2 (2nd Global conference on Land Ocean Connections) will allow links to be developed including with actions under the Cartagena Convention. The International Nitrogen Initiative (INI) also has a Latin American Center (Brazil) to support demonstration in this region.

[36] http://www.dhan.org/development-matters/2013/02/urea-deep-placement-technology/

Case 3: Regions with transition economies.

- **East Baltic – Neva / Narva** (focus on Russia, Estonia and Latvia). The key issue is general shortage of N compared with 1980s, although rates are increasing, with large pollution point and diffuse sources. GEF support will help to develop the critical mass of the recently formed Expert Panel on Nitrogen in EECCA countries under the TFRN. There are opportunities to strengthen linked delivery between CRLTAP and HELCOM, including short-listing as one of the UNECE Water Convention Nexus assessment areas.
- **Central Asia – Syr Darya** (focus on Kazakhstan and Uzbekistan). The key issue is extremely high use of nitrogen fertilizers (especially in cotton farming), combined with irrigation and water shortages. Satellite data on atmospheric ammonia levels shows this as a global hotspot, while pointing (together with the NUE estimates from *Our Nutrient World*) to an under-reporting of N_r use in national statistics. The location is also short-listed for the UNECE Water Convention Nexus assessment, allowing synergies to be developed.
- **South East Europe, Black Sea – Dniester / Dnieper / Danube** (focus on Ukraine, Moldova, and Romania). The key issue is general shortage of N_r compared with 1980s, while hotspots of increasing pollution persist. Building on previous GEF initiatives relevant for nutrient management, the project will extend these to make the link between water and air pollution and greenhouse gases. The partnership builds on TFRN (EPN-EECCA) and earlier GEF activities (including the Danube-Black Sea Strategic Partnership). Includes a short-listed catchment for UNECE Nexus Assessment.

Case 4: Developed countries with excess reactive nitrogen loss

- **Western Mediterranean** – Tajo/Tagus (Spain, Portugal). This area has major challenges for reactive nitrogen management under arid conditions, linking expertise on water, air, greenhouse gas, with effects on ecosystems and human health, including interactions with ozone pollution. The case study is built up of a network of different players aiming to bring together expertise in agriculture, N_r flows, water pollution, air pollution, biodiversity and greenhouse gases in this region for the first time. The focus of this and other potential demonstration from developed regions will catalyze synergies between ongoing activities representing additional co-financing.

Exchanges between countries with demonstration activities and from non-participating countries will be organised to ensure the proof of concepts are widely disseminated to encourage uptake of the reactive nitrogen management tools and practices (through Component 4).

Depending on stakeholder feedback during the PPG stage and the status of on-going and/or planned N_r projects, the final selection of case studies may include a differentiation between the 'core sites' and 'associated demonstration sites', thereby allowing other regions to become involved as the project develops. By encouraging dialogue at the demonstration sites between the researchers and government representatives, as well as with users (farmers) and producers (industry/private sector) this targeted research project will help to strengthen the science – policy linkages. Partners' involvement in the potential case studies is summarised in Annex 2.

These core demonstration studies, would then be supported by "**preparatory demonstration studies**", the purpose of which is to target additional key areas during the life of the project, gathering data and exchanging information with a small amount of resource (supported by a larger faction of co-financing). Such partners will benefit greatly by being included in the project, and will allow it to develop a much stronger global critical mass and consensus than would be possible by completely excluding these areas. Proposed preparatory demonstration studies would be included for Central Asia (Kazakhstan, Uzbekistan, e.g. focus on Syr Daria and link to UNECE Nexus Assessment) and for Latin America (focus

especially on livestock farming, manure and sewage, building on the initial work of the Latin American Centre of the INI.). The focus on the preparatory demonstration will be on sharing lessons from the INMS project with these regions (and vice versa), with focused travel budget allowing meeting participation and selected INMS expert missions to their regions.

Lastly, it should be noted that the fourth case of Developed region/ too much nitrogen, would not be a focus of the GEF core financing, but would be brought in through co-financing activities, as leading countries seek to demonstrate success stories in key regions and highlight ongoing challenges.

(This component responds to STAP Need 2: Conduct focused action and research in three to five locations, and Need 4: *Move towards an ecosystem-based management approach*).

Component 4: Awareness raising and knowledge sharing

An important objective of this project is to strengthen the research capacity and knowledge on management approaches to improve environmental nitrogen management in developing countries. At the same time it aims to ensure that the tools recommended are functional and meaningful globally. This component will assist with the uptake of research and, from interactive workshops, will ensure that the approaches recommended by this targeted research project 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. For example, preparing guidance and advice for the food supply chain to enable effective and informative information on good nitrogen/nutrient management to be presented on packaging.

This action will include developing the platform within the INMS for the cooperation and diffusion of new technological options, together with analysis of the key points where 'barriers to change' are identified. This will therefore be a key point of contact between the project and the developing intergovernmental policy arena including GPA, CBD, FAO, OECD, EU, as together with business and civil society groups to assist in strengthening the science- policy links on reactive nitrogen within the environment. At the same time, by strengthening public engagement (Track 3), this will feedback for the project to make more effective contributions from its scientific analysis (Track 2) into the policy domain (Track 1). To ensure effectiveness in this area, significant resources will be dedicated, including substantial co-funding from the project partners, towards public awareness including: a) web based platform and multi-media tools, b) dissemination activities to diffuse best innovative technologies and best practices, c) finessing of key messages to support media engagement, including with the UNEP Division of Communications and Public Information (DCPI), the London-based Science Media Centre, and US-based Media Resources Ltd (nitrogennews.com), d) reporting of outcomes to governments and considering their feedback, especially utilizing the GPNM as a vehicle to engage with the GPA, the annual UN Environment Assemblies (former UNEP Governing Council and Global Ministerial Environmental Forum), and at further UN and other intergovernmental venues as opportunities arise.

The project preparation phase will consider the information needs of policy makers to refine the INMS structure so that it can be most effective in supporting transformational change by the policy frameworks. The project will also actively support the involvement and sharing of information between the private sector (including farmers, industry associations and producers) and the science –policy dialogue. In particular, the project will work to identify key 'nitrogen champions' among governments, business and civil society, who are ready to work with the project and publicise the nitrogen opportunities that it highlights.

(This component responds to STAP Need 4: *Move towards an ecosystem-based management approach*)

Planned PPG Activities

The PIF anticipates a number of key activities that will be undertaken during the PPG stage to improve the understanding of the problem, to improve the definition of the solution to these problems and to refine potential means to ensure the sustainability of the proposed INMS. These activities include:

- **Formation of a Scientific and Policy Advisory Group** (SPAG) that will identify important linkages between science and policy related to N_r and provide recommendations on approaches to improve the adoption of concepts during the PPG phase. Membership of the SPAG would be from a range of interested stakeholders including science and policy experts, farmers, bio-fuels refiners, producers (including the private sector), civil society, etc. It is anticipated that this advisory group would be continued during the main project implementation to further provide advice on the critical science-policy interface. The work of the SPAG will be closely linked to defining the approach defined as 'Track 1' above. In addition the SPAG will also strengthen this

Project understanding of the water/food/energy nexus and how the INMS can build on practical experiences from Denmark and elsewhere on nutrient use efficiency;

- **Review the role of the GPA or alternative body.** As indicated elsewhere in the PIF, to review the strengths and weaknesses of the GPA as a potential body to sustain the INMS in the longer-term, or to identify alternative institutions if required. In developing this proposal it was highlighted during stakeholder consultations with government representatives (June 2011, London) that there was preference for building on existing agreements and institutions rather than considering developing new structures;
- **Identify the pilot project activities and locations.** As described under Component 3 (above), a detailed review will be undertaken of potential demonstration activities and locations that build on existing or planned interventions (both GEF and non-GEF funded);
- **Elaborating links with GNF and other interventions.** To ensure minimal overlaps with other GEF and non-GEF interventions a review of what the linkages potentially are between projects and the corresponding benefits from and to the INMS Project and to clearly ensure that planned activities do not replicate or overlap these other projects.
- **Public participation and communication**. An outline public participation and communication strategies will be developed to both identify related issues and concerns and to begin the process of raising the concerns of excess nitrogen within the public and political perceptions. The strategies will also assist with outreach to key stakeholders that will be involved in the subsequent implementation of the project including both the private sector and farmers groups**.** Through key project partners (e.g. International Fertilizer Association – IFA) an improved understanding of the product cycle of fertilizer and feedstock (for example) will be developed to guide future communications and stakeholder briefings.
- **Fast-tracking of project results into new GEF IW projects.** As a targeted research project it is essential that the results, experiences, knowledge etc. gained from the INMS activities are mainstreamed in new GEF VI International Waters Projects (and that these results are made available through IW:LEARN to existing projects). During the PPG phase an approach to share this information with GEFSEC and the GEF Agencies will developed and to identify means to ensure that during the main implementation these are able to participate in key meetings and discussions. This will enable the results of the INMS to have impacts within the GEF VI project cycle rather than waiting to the Project closure and the publication of all results.

Project Implementation Arrangements

The project will be **implemented** by UNEP with responsibility for overseeing the Project's compliance with GEF and UNEP policies and providing linkages with other GEF and UNEP initiatives on nutrient management. Subject to further elaboration during the PPG, it is proposed that the Project be **executed** by the International Nitrogen Initiative (INI) which is established under the IGBP (International Geosphere-Biosphere Programme) and SCOPE (Scientific Committee on the Problems of the Environment), and hosted by the UK Natural Environment Research Council (NERC Centre for Ecology and Hydrology). The proposal to use INI reflects its core mandate to lead global and regional scale analysis of the problems of excess and insufficient reactive nitrogen, allowing GEF to benefit from the extensive global and regional networks of INI in science, management practice and at the science-policy interface. The INI project office at NERC has extensive experience in coordinating large international projects, including NitroEurope (28 M€, 64 institutes), ÉCLAIRE (11M€, 38 institutes), and the UNECE Task Force on Reactive Nitrogen (TFRN), as well as the European Nitrogen Assessment and the '*Our Nutrient World*' reports.

The project will work through networks of experts, as tentatively outlined in Annex 1, which will be formed to encourage both South-South and South-North exchanges and sharing of experiences and data, leading to both capacity development in reactive nitrogen understanding and research, and a

sustainable global network that will be capable of continuing to update and refine global nitrogen assessments in the future.

It is proposed that the project management unit be provided by the chair of INI through the NERC Centre for Ecology and Hydrology) based in the UK.

A.1.4 Incremental Cost Reasoning

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.

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.).

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.

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. The GEF contributions will further support understanding and information sharing through the undertaking of targeted demonstration activities in the selected case studies. These will complement and build partnerships with other regional activities, such as the developing focus on Central Asia of the UNECE Transboundary Water Convention addressing the water-food-energy-ecosystems nexus, thereby developing the links between the UNECE Water and Air conventions with the GPA and other bodies (See Annex II).

A.1.5 Global Environmental Benefits

The INMS project is expected to develop international understanding of the nitrogen cycle with a focus on developing consensus on an agreed and harmonized approach to the necessary information chain of drivers, pollution sources and threats, benefits, and control opportunities. It will provide the necessary foundation to foster improved policies and management procedures for mitigating the impacts of excess and insufficient reactive nitrogen, demonstrating how actions to protect the marine environment can provide simultaneous co-benefits for food security, health and the environment. Supported by the cost-

benefit analysis, the project will therefore demonstrate how a shared vision of the many benefits for better nitrogen management can substantially strengthen the work of GEF International Waters.

The project will similarly strengthen research capacity through the use of scientific and technical networks and exchanges in developing countries and will result in improved capabilities to develop local solutions to combating the problems of excess and insufficient reactive nitrogen. In addition, the improved understanding and application of the management tools developed by this project will provide multiple benefits for biodiversity, sustainable land development, greenhouse gas emission reduction and pollution control that will contribute to enhanced food security, improved livelihoods and reduced pressure on the global ecosystem.

The development of a harmonized approach to quantifying the nitrogen cycle will also strengthen the role of the GPA and other intergovernmental frameworks in providing leadership in global assessments, and summaries of impacts and trends on reactive nitrogen (Track 1). This will facilitate their subsequent use for developing global consensus for policy making and quantitative assessment of progress (Track 2).

By including regions where soil nitrogen is depleted for agriculture, the project will also assist with ensuring that policies are introduced to prevent future hot-spots arising through inappropriate use of fertilizers and manures, which may arise in future as developing regions are expected to increase their Nr inputs (e.g. Sub Saharan Africa). This will assist farmers with freeing of capital by reducing waste from excess use of fertilizers and thus making a contribution in improving their livelihoods and strengthening food security in these regions.

The recently published *Our Nutrient World* concluded that if the global community could reach agreement on an appropriate inter-governmental process to lead nutrient management in the 21st century (for example the GPA) and if Nutrient Use Efficiency (NUE) was utilised across the global supply and use of nitrogen, there would be significant scope to introduce targets that can realise significant benefits. For example, the report stated: '*Nutrient Use Efficiency represents a key indicator to assess progress towards better nutrient management. An aspirational goal for a 20% relative improvement in full-chain NUE by 2020 would lead to an annual saving of around 20 million tonnes of nitrogen ('20:20 by 2020'), and equate to an initial estimate of improvement in human health, climate and biodiversity worth over $100 billion per year.'*

A.1.6 Innovativeness, Sustainability and Potential for Scaling-Up

This targeted research project's innovation 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) to be developed 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.

Significant business opportunities in the private sector can be anticipated through improved nitrogen management. Currently around 120 million tonnes of nitrogen fertilizer are manufactured, worth around 120 billion US$ annually. This can be combined with another $60 billion worth of N acquired through biological nitrogen fixation[37]. The substantial value of the nitrogen resource points clearly to

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

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 (Figure 1. Inventory of Options for Action), including the active involvement of the OECD and business related groups including the International Fertilizer Manufacturers Association, Fertilizers Europe, the (industry sponsored) International Plant Nutrition Institute, the International Federation of Organic Agricultural Industries, and the federation of agricultural engineers, through the CEMA aisbl – European Agricultural Machinery. The developing business network continues to be built through interventions at key international conferences (e.g. European Green Week, Brussels; G8 Summit Northern Ireland, 2013), and will substantially increase in gravity through the PPG phase and during the project itself.

As identified in *Our Nutrient World*, a particularly innovative option is the potential to recycle nitrogen oxides, the release of which currently produces 40 million tonnes of reactive nitrogen annually. Current clean technologies focus on denitrification, which converts this N_r back to N_2 wasting the resource – pointing to the need to stimulate international action to develop economic approaches (including development incentives) to recycle this nitrogen through future NO_x Capture and Utilization (NCU) technologies. While the project will thus address novel opportunities, it will also address the scaling up of existing innovative approaches. For example, through the International Fertilizer Development Council (IFDC), substantial effort has already been placed in up-scaling the use of urea deep placement (UDP) approaches to reduce ammonia emissions and improve NUE across Bangladesh. The South Asian case study will allow an examination of the differences with India and other countries, allowing the barriers to a more wide adoption to be addressed. While the project particularly focuses on agriculture, it will also address waste water treatment options by establishing links to the new Global Partnership on Waste Water (GPWW) recently established by GPA, including an emphasis on the opportunities for sewage N resource recycling (rather than denitrification) as highlighted by *Our Nutrient World* (Chapter 6, Key Action 7, p 69).

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, FAO 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 in the environment.

Finally, the GEF contribution will be an important catalyst for further understanding and managing all nutrients. 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.

A.2 Stakeholders: engagement in project preparation

The Project will engage with a wide range of stakeholders during both the Project Preparation Grant (PPG) stage and during implementation. Initial analysis of potentially involved stakeholders include: international organizations (including regional programmes), private sector groups and civil society (including scientific groups). More specifically, these include:

International Organizations:

- Global Programme of Action for the Protection of the Marine Environment from land-based Activities (GPA) and its member states;
- UNEP Regional Seas Programme to assist dialogue with national policy makers involved in marine pollution prevention and protection;
- UN CBD as a key stakeholder in nitrogen indicator development through the Aichi Process;
- HELCOM with support to potential case studies or demonstration activities with data provision in the East Baltic/Russia;
- Cartagena Convention with specific interest through the Protocol on Land-Based Sources of Marine Pollution;
- Black Sea Commission (BSC) and links with the International Commission for the Protection of the Danube River (ICPDR);
- OSPAR – with dissemination, exchange on best practices and provision of data;
- UNECE Convention on Long-range Transboundary Air Pollution and its task force on reactive nitrogen – with a key role in developing atmospheric ammonia mitigation and regional nitrogen budgets;
- UNECE Water Convention with links to regional programmes including agriculture- food-water nexus and potential demonstration activities in East Baltic and Central Asia;
- UNESCO International Oceanographic Commission (IOC), and links to global watershed modelling, including with the NEWS model.
- UNESCAP – with dissemination of best practices and case study involvement;
- OECD – development of regional indicator approaches including nitrogen budgeting;
- FAO – exchange of options for livestock management practices and provision of statistical information;
- Consultative Group on International Agricultural Research (CGIAR) – exchange of information and best practices, and potential partners in demonstration activities;
- WMO – links to Global Atmospheric Watch data on nitrogen concentrations in the atmosphere and nitrogen deposition;
- International Fertilizer Development Centre (IFDC) – with information and experience exchange;
- IIASA – contributions towards the development of integrated models, nitrogen budgets and analysis of future scenarios;
- Scientific Committee on Problems of the Environment (SCOPE) – international science coordination support, and one of the supporting bodies of the INI.
- International Geosphere Biosphere Programme (IGBP) and “Future Earth” – global science dissemination under the auspices of the International Council on Scientific Unions (ICSU), executed through the International Nitrogen Initiative (INI) as lead agency of the project, hosted by the UK Natural Environment Research Council (Centre for Ecology and Hydrology).
- European Commission – involved through both its Joint Research Centre as a project partner, and in funding activities in support of the INMS, including NitroEurope, ÉCLAIRE and future programmes.

Private Sector and Business Associations

- International Fertilizer Manufacturers Association (IFA) - perspective from industry, including potential co-financing;
- Yara International - perspective from industry, including potential co-financing;
- BASF – perspective from industry, including innovation in developing fertilizer enzyme inhibitor products;
- Fertilizers Europe – perspective from industry, including potential co-financing;
- European Agricultural Machinery federation (CEMA aisbl) – perspective on technologies innovation;
- Coastal fisheries organizations - improved management strategies and actions that reduce coastal hypoxia;
- International Plant Nutrition Institute (supported by the fertilizer industry) – on approaches for improved nitrogen stewardship;
- International Federation of Organic Agricultural Movements (IFOAM)
- In addition to these established partners, who have already expressed their interest in the work ongoing networking will allow further key business partners to be invited to contribute during the preparation phase, including:
- Farmer Unions, such as the European Farmers Union (COPA-COGECA) and other regional bodies, who are already engaged with the project partners at the regional scale;
- World Business Council for Sustainable Development (WBCSD), to encourage the mainstreaming of nitrogen issues at a higher level into green economy thinking;
- Relevant small and medium size businesses offering key innovation opportunities (e.g. MakingEnergy.com: scaling up ammonia recovery in biogas production, already in contact with the project partners through the UNECE Task Force on Reactive Nitrogen)..

Civil Society

- Packard Foundation - development of integrated approach to nitrogen management and positioning of nitrogen in relation to global sustainability challenges;
- World Wide Fund for Nature Conservation (WWF), provision of information underpinning the development of Planetary Boundaries (including the Planetary Boundary Initiative)
- OXFAM, exchange of information on nitrogen friendly farming practices
- Friends of the Earth, information on the integration of nitrogen use efficiency in relation to societal consumption choices, and public awareness on the global nitrogen challenge.
- Society of Nature Conservation in India.
- Further civil society groups will be involved in building up the regional demonstration activities during the project preparation phase.
- Other science partners are listed under the co-financing section.

Stakeholder involvement in project preparation

The stakeholder contribution to the INMS project development can be seen in four stages:

- **Stage 1: Background network development.** Substantial efforts have been placed by INI and its partners over the last 10 years in developing regional and global nitrogen stakeholder networks, including links to regional and global environmental policy, private sector and green economy opportunities, and with civil society organizations. This networking has benefited significantly from the actions of the GPA, GPNM (including through the GNF project), TFRN and the key international conventions and has been instrumental in bring the nitrogen challenge to global public attention. It is also this ongoing background network development that has allowed the critical mass of stakeholders to be brought together in this outline proposal.

- **Stage 2: INMS outline proposal development.** Stakeholders were supplied with background information on the developing INMS concept and invited to get involved, including to express their interest in key parts of the programme, indicating what they may offer (including co-financing contributions), and to make recommendations for tuning of the outline proposal. Networking by the INI chair and regional centre directors have fostered the building of the critical mass, including presentations to the GEF-STAP and to the European Parliament.
- **Stage 3: Project preparation phase.** The PPG will allow the project stakeholders to be brought together with the researchers in a series of regional and global meetings to refine the project goals and comprehensive project work plan. To improve effectiveness, a series of meetings is envisaged that builds on existing networking activities (e.g. including at the 2nd Global Conference on Land Ocean Connections, GLOC-2, Jamaica; and the 6th International Nitrogen Conference, N2013, Kampala; United Nations Environment Assembly, Spring 2014, Nairobi), complemented by specific targeted workshops. This will allow development of the broad perspective with key global stakeholders, followed by more focused efforts in developing the regional demonstration activities. A key part of this activity will be to confirm the procedures for governance and stakeholder advice to the project.
- **Stage 4: Project implementation.** Finally, the project implementation should be seen as supported by an ongoing process of stakeholder advice. Subject to agreements during the project preparation phase, it is anticipated to support the project Executive Board (EB) with a full Stakeholder Advisory Council (SAC). To ensure effectiveness, the SAC would consist of representatives of all contributing stakeholder groups, while being supported in its work through a smaller Stakeholder Advisory Board (SAB), appointed from the SAC membership. Rules of procedure for these groups will be established during the project preparation phase

A.3 Risk:

Risk	Rating	Mitigation Strategy
Failure to agree on common global approaches for indicators and models	L	Development and utilization of inclusive networks (through GPNM) of scientists and policy makers to ensure that demand for relevant information is met by the supply of appropriate indicators
Country buy-in	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, Farmer Organizations) and NGOs (e.g. WWF, Oxfam etc.) to facilitate the global dialogue on nitrogen
GPA buy-in	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.
Willingness to utilize approaches for developing strategies for addressing low nitrogen levels	M	Close co-operation with countries and fertilizer industry will assist with mitigating negative impacts of over-supply of nitrogen containing fertilizers.
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	M	Improved awareness and dialogue between researchers and

communication between science assessments and policy development		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 UNEP Environment Assembly, CBD, regional air/water conventions, OECD, business groups, civil society etc. This will develop the network of key 'nitrogen champion's to ensure that the outcomes of the project are used.
Interactions with other multiple stressors (e.g. climate change)	M	The development of N cycle tools will include assessing linkages with other global stressors interacting with N_r

A.4 Coordination

This project 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.

The project will clearly build on previous GEF interests in nutrients and coastal eutrophication (through GEF IW projects including the support to GPNM activities and the TWAP with an expectation of an exchange of data and methods). Specifically the GEF Global Nutrient Foundations (GNF) project provides an important resource in its partnership to build the present programme, through its delivery of a tool box of options for nutrient management in coastal zones, and in its demonstration of good practices through two case study areas. Global datasets prepared as a result of the GNF project will feed directly into the baseline of the present INMS project (see also Box 1).

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.

The Project 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 INMS 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 ammonia mitigation, on regional nitrogen budgets and in future integrated approaches to nitrogen mitigation.

Existing international research efforts include major programmes supported by the European Union, such as the NitroEurope Integrated Project (64 partners, €28M) and the ÉCLAIRE project (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. The INI office has already prepared a future research strategy document in support of this process[38], and is actively engaged in developing the research agenda with the European Commission (DG Research and DG Environment), including the potential for projects through the forthcoming Horizon 2020 programme and the European Strategies for Research Infrastructures (ESFRI) programme. Through the INMS project, GEF can therefore substantially multiply its impact by stimulating such future funding activities.

B Description of the consistency of the project with

B.1. National strategies and plans or reports and assessments under relevant conventions

The development of the International Nutrient Management System through this project will assist with improving the knowledge-base available and in an easily accessible manner through the GPNM web platform to support coordinated action at various levels in support of nutrient-related activities of the GPA at global, regional and national levels. 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…*".

The INMS Project will assist the strengthening of national and local capacities to implement appropriate nitrogen management approaches to address excess nutrients. 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. Subject to building the agreement with governments, these activities will further strengthen the GPA as the lead global body for addressing key nutrient issues, while supporting a process where the co-benefits of improved nutrient nitrogen management can provide a shared gravity to support common action.

The outputs of this project will assist regional water conventions (e.g. Danube/Black Sea Conventions, Cartagena Convention and protocol on Land-Based Sources of Marine Pollution, 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), will benefit the Convention on Biological Diversity (CBD), as it seeks to develop and implement indicators in relation to the Aichi Targets (e.g. as recently discussed at the CBD CoP, November 2012).

As the project progresses over the proposed 4 years, there will be substantial potential to further develop the links with other policy domains, showing how nutrient management practices can also deliver to support additional 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 Convention on Long-range Transboundary Air Pollution (CLRTAP). Similarly, improved nitrogen management will contribute significantly to meeting food security goals identified by FAO.

[38] *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).

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.

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

The 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….*'.

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.

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, supporting Millennium Development Goals 1 and 7. 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).

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).

B.3. The GEF Agency's comparative advantage for implementing this project

UNEP's comparative advantage is centred around information management, scientific assessments and early warning (notably related to the Global Environment Outlook process), as well as science to policy linkages at national, regional and global levels, such as in the work on ecosystem-based management, building upon the findings of the Millennium Ecosystem Assessment. UNEP hosts the coordination office of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA); the only global intergovernmental programme that addresses the connectivity between freshwater and the coastal environment. The GPA provides leading advice to countries to help them address land based sources of marine pollution such as nutrients, including through National Programmes of Action (NPAs) that implement the GPA at the national level. The 2002 World Summit on Sustainable Development committed governments to advancing the implementation of the GPA with a focus on wastewater, physical destruction and alteration of habitats, and nutrients. Given the leadership of UNEP and GPA, this project will capitalize on UNEP's experience and UNEP led existing networks.

As an intergovernmental mechanism, the GPA targets major threats to the health, productivity and biodiversity of the marine and coastal environment resulting from human activities on land, using an integrated, multi-sectoral approach, based on commitment to action at local, national, regional and global levels.

One of the key GPA approaches is to implement actions to reduce pollution through National Programmes of Action (NPAs). 72 countries have established framework NPAs since the inception of the GPA. This has enabled countries, through policy measures and pilot projects (e.g., use of constructed wetlands for wastewater management which has reduced pollution load by 90% - St. Lucia), to integrate coastal and marine environmental management and pollution reduction measures into national sustainable development plans/strategies and budgetary mechanisms.

Implementing the GPA is primarily the task of national Governments, while UNEP, as secretariat, through the GPA Coordination Office, facilitates implementation at the national, regional and international levels. The GPA Coordination Office received a new mandate, through its Intergovernmental Review in 2012, which resulted in agreement by governments on the Manila Declaration, and acknowledged that the GPA is an effective tool for integrating environmental concerns into development planning and strategies at the international, regional and national levels. Similarly, paragraph 163 of the "Future We Want" Outcome document also recognized the GPA, wherein countries committed to take action to reduce the incidence and impacts of marine pollution from land-based sources.

The Manila Declaration gave the GPA strategic direction for the period 2012-2016. It has also resulted in renewed commitment of member countries to the GPA and so far has resulted in mobilization of an additional USD1.5M (directly from countries) for work in the three priority areas. The GPA has now focused its future work on the Manila Declaration and the relevant output of the UNEP Programme of Work (i.e. the impacts of land-based activities affecting river basins and coastal areas are reduced through provision of technical support to countries to improve ecosystem management at the regional and national levels). Priority source-categories for the GPA currently include sewage, nutrients, and marine litter. The GPA, through the Manila Declaration, acknowledges the important contribution of multi-stakeholder partnerships, including the importance of public-private partnerships, and United Nations inter-agency partnerships in the implementation of the GPA. In this regard, related activities to support the Declaration and the UNEP Programme of Work (PoW) include the establishment of global multi-stakeholder partnerships for marine litter and wastewater, and strengthening of the existing Global Partnership on Nutrient Management (GPNM). Each of these partnerships, managed by GPA, include (or will include) strong private sector, academic, and institutional representation[39].

[39] Membership of the GPNM includes: **the Governments** of the Netherlands, USA, Italy, Indonesia, India, and Thailand; the UK Natural Environment Research Council Centre for Ecology and Hydrology; the European Commission; the Task Force on Reactive Nitrogen under the Convention on Long Range Trans-boundary Air Pollution of the UNECE; South Asia Cooperative Environment Programme (SACEP); the UK-China Sustainable Agriculture Innovation Network (SAIN); **such private sector institutions as** the International Fertilizer Industry Association (IFA), International Plant Nutrition Institute (IPNI), International Fertilizer Development Centre (IFDC), World Phosphate Institute (IMPHOS), and Nagarjuna Fertilizers & Chemicals Ltd, India; UNESCO's Intergovernmental Oceanographic Commission (IOC/UNESCO), the Food and Agriculture Organisation (FAO), UN-Habitat, the International Atomic Energy Agency's Marine Environment Laboratories (IAEA/MEL), and the United Nations Development Programme (UNDP); **such academic and research institutions** as the International Nitrogen Initiative (INI), the International Geosphere-Biosphere Programme (IGBP), the Scientific Committee on Problems of the Environment (SCOPE), The Netherlands Energy Research Centre, the Netherlands Environmental Assessment Agency, the Department of Earth Sciences and Geochemistry, Faculty of Geosciences at Utrecht University, Vrije University, the Institute of Oceans Management, India's National Centre for Sustainable Coastal Management, the

The partnerships are responsible for helping to collate scientific knowledge to be used in taking policy decisions and to mobilize technical support for partners in their endeavours to tackle the issues involved. This would drive forward necessary institutional and policy changes in key sectoral activities, thereby enabling the GPA to add value. Beyond the traditional bi-lateral support provided to the GPA (e.g. NOAA), non-traditional partners have come on-board to work with the GPA. These include the private sector (e.g. the International Council of Chemical Associations), NGOs and a broad base of UN partners (s.a. UN-Habitat; FAO; WHO; IMO; World Bank).

The GPA envisages more comprehensive approaches for reducing ocean pollution. In the areas of nutrient management, as an example, the GPA is addressing how to reduce the amount of excess nutrients in the environment without hindering global development, by providing a platform for governments, the scientific community, the private sector, civil society organizations and UN agencies to enter into dialogue in forging a common agenda, mainstreaming best practices and integrated assessments, so as to effectively 'nutrient proof' policy making and investments. The GEF IW Strategy complements the collaboration through targeted research and with the private sector started by the GPA.

Through its programmes, the GPA has contributed to eradicating poverty as well as sustained economic growth, improving human welfare and creating opportunities for employment, while maintaining the healthy functioning of the Earth's ecosystems, consistent with green economy approaches. The GPA remains a valuable and flexible tool to achieve targets set by the international community as they relate to the coastal and marine environment and their associated watersheds. Based on recent work supported by the GPA, in the management of the coastal and marine resources, including addressing land-based sources of pollution, the economic dimension that was missing or overlooked so far has now been recognized. Governments and other stakeholders have increasingly recognized the contribution of the coastal and marine resources in their national economies and their enormous income generating potential, when they are sustainably managed with adequate safeguards. The GPA is an important vehicle to catalyze investments and enhance multi-state co-operation having served as a key platform for GEF implementation, including through Large Marine Ecosystem (LME) projects globally. In order to advance this intergovernmental programme, continued support from the GEF, as the only existing financial mechanism to address international waters, is critical.

Indian Nitrogen Group, China Agricultural University and the Department of Marine Science at Chulalongkorn University, Thailand; Nutrient Platform Netherlands; Global TraPs; University of Peradeniya, Cyprus University of Technology; **civil society organization**: The Nature Conservancy, Society for Conservation of Nature in India, Global Environment and Technology Foundation, Water Stewardship Inc. and regional bodies and projects such as Bay of Bengal Large Marine Ecosystem Project (BOBLME), Partnerships in Environmental Management for the Seas of East Asia (PEMSEA).

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

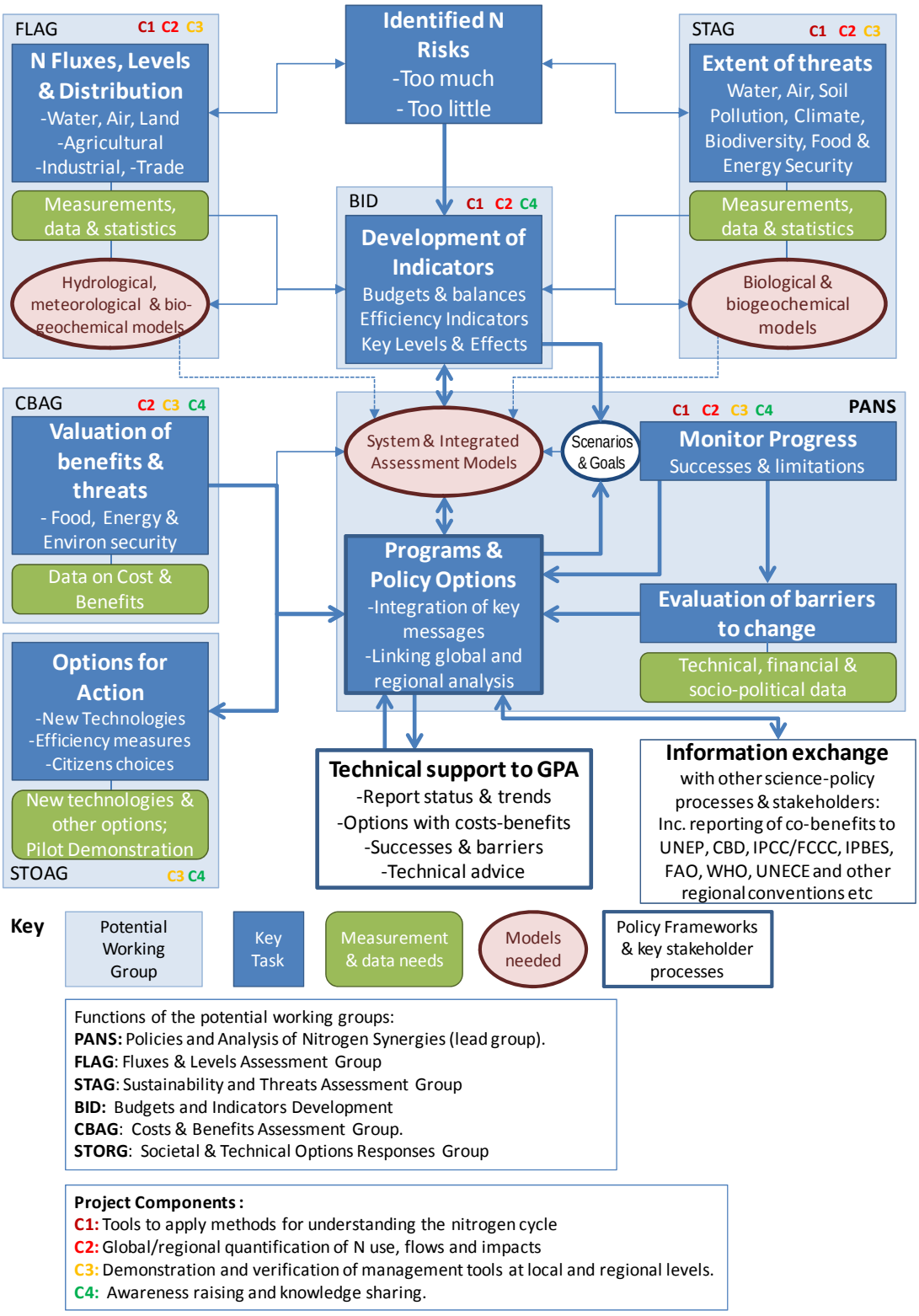
A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT (S) ON BEHALF OF THE GOVERNMENT(S): (Please attach the Operational Focal Point endorsement letter(s) with this template. For SGP, use this OFP endorsement letter). **N/A**

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 project identification and preparation.					
Agency Coordinator, Agency name	**Signature**	**Date (MM/dd/yyyy)**	**Project Contact Person**	**Telephone**	**Email Address**
Maryam Niamir-Fuller Director, GEF Coordination Office, UNEP		01/14/2013	Isabelle Van der Beck Task Manager	+1-202-974-1314	Isabelle.vanderbeck@unep.org

Annex 1: Figure 2 - Potential network and linkages for the International Nitrogen Management System (INMS) Project – illustrating tasks, data, models & potential working groups. A simpler version of this diagram highlighting the project deliverables is provide in the main text (Figure 1).



Annex 2: Potential Regional Case Studies for Demonstration of nitrogen management strategies to be developed in the project, highlighting the potential involvement of key regional partners. Note that the global frameworks GPA and CBD and other international partners such as FAO are associated with all the case studies. This table indicates only major links as a starting point for further development. The rationale for selecting these regional case studies is summarized at Section A1.3 (Component 3) . For brevity only selected partners are indicated here (see Annex 3 for full list of partners); other partner links and the final selection of case studies will be developed during the project initiation phase.

Potential Regional Case Study	Key Regional Partners	Key supporting global partners	Indicative links with ongoing policy processes, business and NGOs
East Baltic (Neeva)	Russian Academy of Agricultural Sciences, Institute of Mechanisation; Institute of Manure Management (Leads on the TFRN Expert Panel on Nitrogen in EECCA countries).	RIVM, NL, Umweltbundesamt, DE; ALTERRA, NL CEH, UK.	UNECE Air Convention; HELCOM; UNECE Water Convention; Fertilizers Europe;
Central Asia (Syr Darya)	Kazakhstan Institute of Ecology	CEH, UK; IIASA	UNECE Water Convention; International Fertilizer Manufacturers Association,
North China Plain	Chinese Agricultural University; Chinese Academy of Sciences	ALTERRA, SAIN, IMK, Rothamsted Research	International Fertilizer Manufacturers Association; International
East and SE Europe	Czech Ministry of Agriculture and associated institutes; Institute of Ecology and Hydrology, Romania; Ukraine Institute of Ecology	IIASA; European Commission-JRC; University of Pierre and Marie Curie, FR	UNECE Air and Water Conventions; Fertilizers Europe
West Mediterranean	University Polytechnica Madrid, Spanish Ministry of Environment, and other partners	CEH, UK European Commission-JRC; University of Pierre and Marie Curie, FR	UNECE Air and Water Conventions; Fertilizers Europe
North East India / Bangladesh	Indian Nitrogen Group, IIARI and other	International Fertilizer Development Centre; Rothamsted Research;	International Fertilizer Manufacturers Association, Society for Nature Consevation of India
Sub-saharan Africa (Lake Victoria)	CGIAR Institutes (under lead of International Livestock Research Institute).	Institute of Meteorology Karlsruhr; IIATA;	International Plant Nutrition Institute;
Latin America	Ministry of Environment of Brazil; Brazil national space agency	Woods Hole Research Centre, USA	International Plant Nutrition Institute;

Annex 3 - Summary of Partners' Experience/Expertise

Part-ner [40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
			Partners primarily with global focus in the project			
C1	GEF Agency	Policy Support	United Nations Environment Programme (UNEP)	In-kind	2,000,000	**Implementing Agency** for the project, ensuring coordination with GPA and liaison with other international frameworks. Input through secretariat for the GPNM, and liaison with the GEF GNF project.
C2	Non-ministry government body	Science and Policy Support	UK Natural Environment Research Council (NERC), Centre for Ecology & Hydrology, UK, as host of the International Nitrogen Initiative (INI)	In-kind	3,500,000	**Executing Agency** for the project, providing Project Office, project direction and coordination including financial management. Builds on the successful coordination NitroEurope, ÉCLAIRE, European Nitrogen Assessment, *Our Nutrient World*. Chair of the International Nitrogen Initiative. Co-financing supplied through a wide range of UK and EU funded sources, including National Capability.
C3	Other Multilateral Agency (ies)	Science	Secretariat to the Convention on Biological Diversity (CBD), Canada	In-kind	TBD	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), plus liaison in relation to future actions under the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES).
C4	Other Multilateral Agency (ies)	Policy Support	UNECE Conventions on Transboundary Water and Transboundary Air Pollution, Geneva	In-kind	50,000	Secretariat support to foster wider international liaison with the UNECE Convention on Transboundary Water Courses and with the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP), including links to development of the long-term air pollution strategies and the Water Nexus Assessment.
D1	Other Multilateral Agency (ies)	Science and Policy Support	IIASA - International Institute for Applied Systems Analysis, Austria	In-kind	2,100,000	Research contribution in the development of nitrogen integrated assessment modeling linking air pollution, human health, ecosystems, greenhouse gases and water pollution, building on GAINS. Development of regional nitrogen budget approaches and efficiency indicators. Contribution to European scale coordination (Director INI European Centre) and lead Expert Panel on Nitrogen Budgets (EPNB).

[40] Project Partners are here distinguished as: Coordinating Partners (C1..C4), Delivery and Research Partners (D1..D25), Business Sector Partners (B1..B10), Civil Society Partners (S1..S4), Regional Case Study Partners (R1..R37). The final partnership selection will be refined at the PPG phase, including the development of clusters to ensure effective management of the substantial network.

[41] Outline expression of interest, subject to finalization of the plans during the project preparation grant (PPG) phase. TBD = to be determined during PPG phase. NFC = non financing contributor.

Part-ner[40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
D2	Other Multilateral Agency (ies)	Science and Policy Support	European Commission Joint Research Centre (JRC), Italy	In-kind	1,500,000	Research team 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).
D3	Other Multilateral Agency (ies)	Science and Practices	Food and Agriculture Organization of United Nation (Animal Production and Health Division)	In-kind	900,000	Focus on resource use efficiency in livestock supply chains: a) Development of the Global Livestock Environment Assessment Model (GLEAM), including feed production that allow for "full chain NUE" at global scale, by region, commodity and farming systems, b) Multi-stakeholder dialogues on the improvement of resource use efficiency in the livestock sector, Lead on interfacing with the "Agenda of action for sustainable livestock development" and c) harmonized methods to benchmark environmental performance in livestock food chains.
D4	Other Multilateral Agency (ies)	Science and Practices	International Fertilizer Development Center (IFDC), Alabama, USA.	In-kind	2,180,000	Research team and contribution to regional demonstration. Evaluation of improved fertilizer management practices (including multi pollution interactions urea deep placement and other methods), with stakeholder engagement on field practice, incentives and barriers to change. Key involvement in the South Asian, East Asian and Latin American case studies.
D5	Other Multilateral Agency (ies)	Science	World Meteorological Organization, Global Atmospheric Watch, Geneva	In-kind	TBD	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 (in partnership with NOAA).
D6	Other Multilateral Agency (ies)	Policy Support	Organisation for Economic Co-operation and Development (OECD), Paris	In-kind	100,000	Development and dissemination of future high level nitrogen indicator as overall measure of environmental performance (linking air, land, water, climate, biodiversity etc) as a complement to existing high level carbon indicator. Integration of existing agricultural nitrogen balances indicator into full regional nitrogen budgeting approaches.
D7	Non-ministry government body	Science	National Institute for Public Health and the Environment (RIVM), The Netherlands	In-kind	1,000,000	Development of global numerical models using the IMAGE system of nitrogen flows and interactions with other nutrients, including the incorporation of management options and allowing examination of regional differences and system efficiency (builds on and extends advancements made through the GEF-GNF project).
D8	Non-ministry government body	Science and Policy Support	Italian National Agency for New Technologies, Energy and sustainable economic development	In-kind	300,000	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).
D9	Non-ministry government body	Science and Policy Support	PBL Netherlands Environmental Assessment Agency, The Netherlands	In-kind	250,000	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 on the lead of the Expert Panel on Nitrogen and Food.

Part-ner[40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
D10	Non-ministry government body	Science and Practices	Institut Nationale Recherche Agronomique (INRA), France	In-kind	4,000,000	Integration with national research programme on nitrogen and other nutrient interactions in agriculture, including incorporation of results that link air, land and water pollution with expertise on farm-scale modeling and agronomic practices. 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.
D11	Non-ministry government body	Science	National Oceanographic and Atmospheric Administration (NOAA), as a partner of the Global Atmospheric Watch, USA	In-kind	TBD	Delivery partner with WMO on implementation of the Global Atmospheric Watch (GAW), for collation and provision of atmospheric nitrogen and deposition data for model evaluation. Includes gap analysis for key developing regions.
D12	Non-ministry government body	Science	Flemish Environment Agency, Antwerp, Belgium	In-kind	2,000,000	Development of a measurement and modeling strategy to assess the regional effectiveness of existing and new policies to reduce ammonia emissions, including continuous and time averaged measurement systems and the application of atmospheric transport models.
D13	Non-ministry government body	Science	Norwegian Meteorological Institute, Oslo, Norway.	In-kind	1,800,000	Met.no is interested to develop its N-modelling capabilities, provide coupled atmosphere-biosphere simulations of future N-scenarios in different economic and climate change scenarios.
D14	Others	Science and Policy Support	Wageningen University, Netherlands	In-kind	3,000,000	Research on the 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.
D15	Others	Policy Support and Practices	Stockholm Environment Institute	In-kind	3,350,000	Analysis and dissemination of best practice options, including the links between nitrogen and nutrient management with climate and clean air. Lead partner on the developing the liaison in INMS between the GPNM / GPA and the UNEP hosted Climate and Clean Air Coalition. Analysis of synergies and trade-offs.
D16	Others	Science and Policy Support	Energy research Centre of the Netherlands	In-kind	900,000	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. Lead on liaison between INMS and the provision of the nitrogen related indictors under the UN Convention on Biological Diversity. Coordination support through INI Director of Operations.
D17	Others	Science	Woods Hole Research Center, USA	In-kind	500,000	Research on the analysis of links between nitrogen flows and greenhouse gases, especially nitrous oxide, and of options that can simultaneously contribute to reducing overall levels of nitrogen pollution. Regional coordination support as Director of the INI North American Center.

Partner [40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($) [41]	Rational for partner inclusion / contribution
D18	Others	Science and Practices	University of Delaware, College of Agriculture & Natural Resources	In-kind	750,000	Research and dissemination on agricultural practices for improved nitrogen management, integrating the role of crop, livestock and bioenergy systems, with an emphasis on the options for improved manure and fertilizer management to reduce water and air pollution and emissions of greenhouse gases.
D19	Others	Science and Practices	Aarhus University, Denmark	In-kind	2,000,000	Regional scale demonstration of low emission practices including analysis of the practice options and constraints, based on 10 years of low emission practice requirements in Denmark. Analysis of cost effectiveness of options and of synergies / trade-offs between water and air pollution and between nitrogen and phosphorus.
D20	Others	Science and Practices	World Resources Institute, Water Quality Team	In-kind	300,000	WRI are engaged in provision of a global interactive map and data portal for eutrophic and hypoxic areas. They contribute to the evaluation of agronomic practices, policy instruments, and assessment on barriers to change.
D21	Others	Science and Policy Support	IVL Swedish Environmental Research Institute	In-kind	200,000	Research on the linking of ecosystem responses to excess nitrogen deposition through the application of dynamic models, as a basis to refine dose response relationships and examine future scenarios, including assessment of timescales of system recovery. Development of links between air and marine N flow assessment.
D22	Others	Science and Practices	Environment Centre Wales, Bangor University	In-kind	52,000	Focus on: a) promoting efficient use of nitrogen within ruminant livestock systems, minimising N leakage to the environment, including improved manures management, b) optimisation of fertilizer N to maintain a given level of production, c) analysis of policy & practice facing research and farmer guidance, including socio-economic barriers to new technology/policy adoption by farmers.
D23	Others	Science	CNRS/University Pierre et Marie Curie, Paris, France	In-kind	200,000	Developing indicators and modelling tools for assessing the impacts of the excess of nitrogen in the river basin continuum. Analysis of the agricultural system and the food supply chain. Extending our analysis for the European Nitrogen Assessment and *Our Nutrient World* to contribute to the global action on nitrogen management. Special attention to the examination of fertilizer and biological nitrogen fixation strategies.
D24	Others	Science and Dissemination	University of Virginia, USA		250,000	Development of the N-PRINT nitrogen foot-printing tool, as a vehicle to support public dissemination of the INMS goals. (in partnership with NL Energy Research Center and Louis Bolk Institute of the Netherlands, and selected demonstration case regions).
D25	Others	Science, Practice & Dissemination	Louis Bolk Institute, Netherlands.		90,000	Work on nitrogen foot printing (N-PRINT), and organic farming approaches in collaboration with University of Virginia, Netherlands Energy Research Center Univ Virginia and case study partners in developing countries, including with excess and insufficient reactive nitrogen.
B1	Private Sector / Business	Policy Interest and Practices	International Fertilizer Manufacturers Association (IFA), Paris, France	In-kind	100,000	Key global stakeholder representing the world's fertilizer manufacturing sector. Provision of information from the industry on fertilizer data and practices and contribution to the dialogue on nitrogen strategies.

Part-ner[40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
B2	Private Sector / Business	Policy Interest and Practices	Fertilizers Europe, Brussels, Belgium	Cash In-kind	20,000 30,000	Regional stakeholder representing Europe's fertilizer manufacturing sector. Provision of information from the industry on fertilizer data and practices and contribution to the dialogue on nitrogen strategies.
B3	Private Sector / Business	Science and Practices	Yara International ASA, Research Centre Hanninghof, Germany.	In-kind	100,000	Global fertilizer manufacturer and provider of advice services to farmers. Provision of information from the industry on fertilizer data and practices and contribution to the dialogue on nitrogen strategies.
B4	Private Sector / Business	Science, Policy and Practices	PigCHAMP Pro Europa (PCH), Spain	In-kind	400,000	Major pig producer, involved as stakeholder reflecting livestock sector interests. PCH, as a company dedicated to livestock consulting, wants to be at the forefront of knowledge. Provision of: knowledge acquired in the implementation of the IPPC Directive in the livestock sector. The necessary contacts for collaborating farms within the livestock sector in Spain (see also Mediterranean Case Study).
B5	Private Sector / Business	Science and policy interest	International Plant Nutrition Institute (IPNI), United States.	In-kind	150,000	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.
B6	Private Sector / Business	Science and practices	BASF, Division of Plant Protection, Germany	In-kind	TBD	Development of fertilizer products and practices with an emphasis on improving nitrogen use efficiency and reduction of emissions through the use of novel inhibitor products, including novel urease inhibitors, nitrification inhibitors and future denitrification inhibitors.
B7	Private Sector / Business	Practices Development	CEMA aisbl – European Agricultural Machinery	In-kind	TBD	Interest in the development of low emission practices, especially in regard of manure spreading methods, including liaison with other regional agricultural machinery organizations.
B8	Private Sector / Business	Practices Development and Policy	Technology Innovation Platform (TIPI) of the International Federation of Organic Agriculture Movements (IFOAM)	In-kind	TBD	Interest in the advancement of organic agriculture through, research, development, innovation and technology transfer. The contribution will consider the extent to which the more complex forms of nitrogen used in organic agriculture are more slowly released and are therefore less likely to leach, volatilize or otherwise cause pollution problems when compared with soluble and volatile sources of ammonia, nitrate and synthetic urea.
B9	Private Sector / Business	Science and policy interest	MakingEnergy, USA	In-kind	TBD	Scaling up improved methods of ammonia stripping for fertilizer manufacture from recycling biogas production streams, linking N and methane practices.
B10	Private Sector / Other	Practices Development	University of Leeds in partnership with Marks and Spencer plc (retail sector).	In-kind	TBD	Development of the understanding and communication of nitrogen challenges in the retail sector, including the refinement with other partners of product nitro-labelling. Builds on existing Knowledge Exchange Fellowship with Marks and Spencer supermarket, with the intention to further develop the network with other companies.

Part-ner[40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
S1	Civil Society Organisation	Policy and Dissemination	World Wide Fund for Nature conservation (WWF), Godalming, UK.	In-kind	TBD	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.
S2	Civil Society Organisation	Policy and Dissemination	Friends of the Earth (England, Wales, and Northern Ireland).	In-kind	800,000	Friends of the Earth has a Water, Land-use and Food Programme to research, raise awareness and advocate solutions. One of the priority areas is on reducing meat consumption, and also relevant to climate change, biodiversity loss and soil erosion. Another priority is biofuels, reported to be implicated in dead zones due to excessive nitrogen use. Joining this project would enable us to ensure we are fully up to date with the nitrogen research, engage policy makers and provide policy feedback.
S3	Civil Society Organisation	Policy and Dissemination	Planetary Boundary Initiative (BPI)	In-kind	200,000	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.
S4	Civil Society Organisation	Policy and Dissemination	Oxfam, Oxford, UK.	In-kind	TBD	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.
S4	Civil Society Organisation	Policy and Dissemination	Other Civil Society organizations.			It is expected to build increased involvement with other civil society organizations as through the regional case studies during the PPG phase and as the project develops.
			Partners primarily with regional demonstration focus in the project[42]			
			CASE 1: Developing regions with excess reactive nitrogen			
R1	Others	Science and Dissemination	Indian Nitrogen Group and the Society of Nature Conservation of India.	In-kind	50,000	**South Asia Case Study:** Widespread use of synthetic fertilizers to boost crop production has resulted bin excessive damage to air and water quality. The contribution will a) coordinate the South Asian Case study (INI Centre Director), comparing the challenges for nitrogen management faced by adjacent states, b) to 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.

[42] The final decision on which case studies to include and the balance of effort between them will be made during the PPG phase. It is expected that not all

Part-ner [40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
R2	Others	Science and Practices	Center for Sustainable Technologies, Indian Institute of Science, Bangalore	In-kind	200,000	**South Asia Case Study:** Focus on sustainable technologies for nitrogen recovery of urban and rural 'wastes', including assessment N-flows, recovery options, adaptation methods devised and policy options.
R3	Others	Science and Practices	Chilika Development Authority and School of Biotechnology, KIIT University	In-kind	500,000	**South Asia Case Study**: Chilika Lake is a unique assemblage of marine, brackish and feshwater ecosystem with estuarine characters and serves as a hotspot of biodiversity. The involvement will allow outputs from the GNF project to be adopted and incorporated into the global analysis including on the status and impacts of N in the environment and related biodiversity in the lake ecosystem.
R4	Others	Science and Practices	Punjab Agricultural University/Indian Nitrogen Group	In-kind	20,000	**South Asia Case Study:** In the coming years agriculture in India will witness a delicate balance between input and output of nitrogen. Indigenous soil N supply (INS) has a critical role in influencing N fluxes in soil-plant atmosphere systems. A synthesis of existing methods used for quantifying INS and identifying a robust method would lead to better quantification of N-fluxes from agriculture to other ecosystems and help in developing strategies for efficient management of fertilizer N.
R5	Non-ministry government body	Science and Practices	Indian Agricultural Research Institute, New Delhi, India	In-kind	50,000	**South Asia Case Study:** (a) Demonstrate and upscale the proven site-specific technologies for improving NUE to enhance farmers' income through sustainable agriculture; (b) assess and value N management systems for achieving the maximum co-benefits and mitigation of negative effects of excess or insufficient N, (c) evaluation of indicators for different regional and nutrient flow systems and (d) creating awareness and train farmers for adopting technologies for higher NUE.
R6	Others	Science, Practice and Policies Support	China Agricultural University, Beijing	In-kind	500,000	**East Asia Case Study:** Analysis of nitrogen management practices in Chinese agriculture, quantification of regional flows and comparison with different sources of nitrogen, including fossil fuel combustion and wastewater. Development and dissemination of improved management practices, including development of farmer training partnerships. Analysis of the barriers to change and consideration of policy options.
R7	Others	Science Support	Institute of Soil Science, Chinese Academy of Sciences, Nanjing, China	In-kind	500,000	**East Asia Case Study**: Development of the basis for synthesizing a regional assessment of nitrogen benefits and challenges in China (Director of the INI East Asian Center).
R8	Others	Science Support	Beijing Forestry University (BFU), Beijing, China	In-kind	300,000	**East Asia Case Study:** Detailed overview of N flux, quantification and assessment of threats from excess N in wetlands ecosystems; Evaluation of ecosystem service altered by excess N; Assessment of threats from high atmospheric N deposition

Part-ner[40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
R9	Others	Science and Practices	Rothamsted Research, UK	In-kind	600,000	**East Asia Case Study**: a) Working in partnership with Chinese teams in developing practices for improved nitrogen management in agriculture, with contribution to the regional nitrogen assessment. b) Rothamsted Research has a long history of research on N cycling within agricultural systems with a major focus on improving NUE and minimising losses of N and offers expertise in measurement and modelling, underpinning policy development, and data from research facilities including the North Wyke Farm Platform and the Rothamsted Long Term Experiments.
R10	Others	Science and Practices	UK China Sustainable Agriculture Innovation Network (SAIN)	In-kind	TBD	**East Asia Case Study:** SAIN is a well-established intergovernmental platform between the UK and China, promoting science and policy linkages on sustainable agriculture and food security. SAIN will work with the initiative through: disseminating the findings of this initiative to SAIN audiences through various communication channels; providing research findings achieved by SAIN's researches.
R11	Others	Science and Practices	National Institute for Agro-Environmental Sciences (NIAES), Ibaraki, Japan	In-kind	800,000	**East Asia Case Study:** NIAES has contributed to the elucidation and resolution of a wide range of global environmental issues, including the nitrogen challenge, including agricultural nitrous oxide emissions, nitrate leaching, and local and regional assessments of nitrogen cycle. NIAES will thereby facilitate the involvement of Japanese scientists into East Asian case study.
R12	Others	Science, Practices and Policy support	Brazilian National Institute for Space Research (IPNE), Brazil	In-kind	400,000	**Latin America Case Study:** The Earth System Science Center at INPE focus is here 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). The options for a Latin American case study will be further considered during the Global Conference on Land Ocean Connection (GLOC-2, Jamaica, October 2013).
			CASE 2: Developing regions with insufficient reactive nitrogen			
R13	Multilateral Agency (ies)	Science support	CGIAR: International Center for Tropical Agricultural, Research Program on Climate Change, Agriculture and Food Security, in cooperation with the International Livestock Research Institute (ILRI), Kenya	In-kind	2,000,000	**Lake Victoria Case Study:** Development of the Lake Victoria nitrogen management case study, extending current and previous CGIAR and GEF initiatives on greenhouse gas fluxes and water quality to develop a comprehensive approach on N management. Contribution, also to land management and interactions between nitrogen fluxes and livestock management systems globally. The Lake Victoria case study delivered in cooperation further partners noted below, IPNI and others

Part-ner [40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
R14	Others	Science and Practices	Karlsruhe Institute of Technology, IMK-IFU, Germany	In-kind	150,000	**Lake Victoria Case Study**: Key research partner supporting through cooperation with the International Livestock Research Institute (CGIAR-ILRI), CIFOR, International Institute for Tropical Agriculture, International Centre for Research on Agro-Forestry (ICRAF) and local institutions including KARI, Kenya, Makerere University, Uganda, Sokoine University, Tanzania.
R15	Others	Science, Practices and Policies	International Institute for Tropical Agriculture (IITA), International Centre for Research on Agro-Forestry (ICRAF), Kenya, Makerere University, Uganda and Sokoine University, Tanzania.	In-kind	TBD	**Lake Victoria Case Study:** Further delivery partners, in cooperation with CGIAR and IMK-IFU, with the details to be further developed during the PPG phase.
			CASE 3: Nitrogen challenges for transition economies			
R16	Non-ministry government body	Science and Practices	State Scientific Institution "North-West Research Institute of Agricultural Engineering and Electrification (SZNIIMESH) of the Russian Academy of Agricultural Sciences	In-kind	100,000	**East Baltic Case Study:** SZNIIMESH will focus on nitrogen flux control as a part of environmental management on a farm level for the North-West Russia, 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 Russian and international legislation, with the outputs being tested on several pilot farms in the North-West of Russia (Co-chair of the UNECE Expert Panel on Nitrogen in EECCA countries, EPN-EECCA).
R17	Non-ministry government body	Science and Practices	State Scientific Institution, All-Russian Research Institute of Organic Fertilizer and Peat of Russian Academy Agricultural Sciences	In-kind	250,000	**East Baltic Case Study:** 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).
R18	Others	Science and Practices	All-Russian Institute for Agrochemsitry named after Dr. Priyanishnikov	In-kind	240,000	**East Baltic Case Study:** Construction of Russian long-term experiments (LTE)s databases with nitrogen mineral and organic fertilizers, Manipulated site measurements according to the NitroEurope database with information about Vegetation and fertilizer data, Crop management, Soil and vegetation details. Testing of N dynamic models against LTEs data. Using existing N flux/pathway models for regional assessments and visualisation for potential scenarios including climate change.

Part-ner[40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
R19	Others	Science Support	Institute of Physicochemical and biological Problems in Soil Science of RAS	In-kind	40,000	**East Baltic Case Study:** Impact assessment of NO_x/NH_3 emission from anthropogenic sources on forest ecosystems. Analysis of soil and vegetation indicators of excess/insufficient N_r in the forest ecosystems. Calculation of critical loads of nutrient nitrogen for forest ecosystems. Regional estimates of N_2O flux rates in soils of under different land use (forestry, conventional and organic farming systems).
R20	Others	Science and Practices	Water Resources Engineering Institute, Aleksandras Stulginskis University, Kaunas, Lithuania	In-kind	100,000	**East Baltic Case Study:** Recent studies indicate that, despite the drastic decrease of agricultural activity in Lithuania, very little evidence was found that the change had influenced riverine nitrogen concentrations. It is suggested that the limited response to agriculture decline 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.
R21	Others	Science and Policy Analysis	Baltic Nest Institute (BNI), Stockholm University, Sweden [partner working closely with the Helsinki Commission for the protection of the Baltic Sea]	In-kind	100,000	**East Baltic Case Study:** BNI provides decision support on eutrophication on the Baltic Sea as basis for negotiations on nutrient load reduction policies. Application of a model system encompassing nutrient budgets and mechanistic models for catchment and the sea. Contribution with complete regional assessment of nitrogen for the Baltic Sea region including use of 'net anthropogenic nitrogen' (NANI) budgets for catchments, and links to hydrological models for scenarios analysis. Knowledge and models on marine nitrogen cycling and liaison with HELCOM to support policy development.
R22	Government	Science and Policy Analysis	Kazakh Ecology and Climate Research Institute of the Ministry of Environment Protection of the Republic of Kazakhstan (KazNIIEK), Kazakhstan	In-kind	TBD	**Central Asian Case Study:** In 2000 the amount of fertilizers were higher by a factor of 2 or 3 compared to the mid of 90's; however they were only 5 % from its amount in 1990, although remote sensing data hint that total amounts is larger than suggested by statistics. The case study will focus on resolving evidence from the different information sources and applying new indicators for assessing N budgets, its levels and impacts, to increase understanding of the N management system, to participate in trainings and working out the national legislation. Links to the EPN-EECCA and the UNECE Water Convention Nexus study will allow wider analysis. *Preliminary discussion has also been conducted with the government of Uzbekistan, through the Convention on Long Range Transboundary Air Pollution.*

Part-ner[40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
R23	Others	Science and Practices	Institute of Agroecology and Environmental Management of National Academy of Agrarian Sciences of Ukraine (IAEM NAAS), Ukraine	In-kind	250,000	**Black Sea Case Study:** The scope of animal farming increased rapidly during the recent years with industrial poultry and pork production leading the growth, followed by beef and dairy cattle production. IAEM NAAS is a leading institution in Ukraine to address the environmental problems caused by increasing livestock production, with a priority to develop an integrated international approach to optimize the nutrient cycles of the planet. The optimization should consider our food and energy needs, while reducing the threat to climate, ecosystem functioning and human health, to improve nutrient use efficiency (NUE).
R24	Others	Science and Practices	National Institute of Research and Development for Marine Geology and Geoecology, Bucharest, Romania	In-kind	400,000	**Black Sea Case Study:** GEOECOMAR is involved in many projects aiming to assess marine and fluvial environmental state focused in relation to anthropogenic factors. They will deliver data from monitoring activities carried out on the Danube River and in the NW Black Sea, providing information for improving N management at local/regional level.
R25	Others	Black Sea Case Study	Slovak University of Agriculture in Nitra	In-kind	150,000	**Black Sea Case Study:** The research is aimed to Nitrogen Use efficiency in terms of fertilizer application with support of new technologies in agriculture. The focus is on optimizing applied nitrogen in order to eliminate the residuals in soil and so e.g. leaching into groundwater. Applied dose is based on the local (site specific) requirements of crop and soil.
R26	Non-ministry government body	Science, Practices and Policy Support	Research Institute of Agricultural Engineering, Czech Republic	Cash In-kind	50,000 100,000	**Black Sea Case Study:** Sharing of techniques learned from European policy processes in agriculture (including Nitrates Directive, Industrial Emissions Directive (pig and poultry) and National Emissions Ceilings directive. Working with a network of farmers to develop and test integrated nitrogen recommendations, including assessment of progress and refinement based on farmer feedback.
R27	Non-ministry government body	Science, Practicies and Policy Support	Crop Research Institute, Czech Republic	Cash In-kind	50,000 100,000	**Black Sea Case Study:** Contributor sharing of experiences for best nitrogen management in crop systems including training for regional 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 intergovernmental processes.
R28	Government	Policy Support	Ministry of Agriculture, Czech Republic	In-kind		**Black Sea Case Study:** Policy analysis of nitrogen mitigation actions in relation to maintaining and improving agricultural performance. Policy lead on ammonia emissions in relation to nitrate leaching and objectives of the Water Framework Directive.

Part-ner[40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
R29	National Government	Practice and Policy Support	Environment Agency, Austria	In-kind	10,000	**Black Sea Case Study:** Provides expertise on the state of the Austrian environment. With regard to air pollution the Umweltbundesamt is the main administrative organization for emission control. The Umweltbundesamt is the national focal centre for Modelling and Mapping of Critical Loads within the Convention of Long-Range Transboundary Air Pollution (CRTAP) and several other air pollution monitoring programs (EMEP, CLRTAP Working Group of Effects, ICP Integrated Monitoring, ICP Vegetation, etc.). *Preliminary discussion has also been conducted with the government of Moldova, through the Convention on Long Range Transboundary Air Pollution.*
			CASE 4: Nitrogen challenges for developed regions with excess reactive nitrogen			
R30	Others	Science and Practicies	Technical University of Madrid / Universidad Politécnica de Madrid, Contamination of agrosystems by agricultural practices (COAPA)	In-kind	300,000	**Mediterranean Case Study:** Focus on the quantification of nitrogen budgets and the losses of reactive N to the environment within Mediterranean crop and livestock systems, with an emphasis on quantification and mitigation of greenhouse gas emissions. Provision of improved nitrogen management and the mitigation of greenhouse gas emissions in Mediterranean agricultural systems based on extensive field research.
R31	Others	Science, Practicies and Policy Support	Technical University of Madrid / Universidad Politécnica de Madrid Group: Ag Systems	In-kind	250,000	**Mediterranean Case Study**: Focus on improving N use efficiency in cropping systems, with particular interest in enhancing crop N uptake and controlling leaching losses, especially from irrigated systems, with interest in N and water management interactions. Consideration of strategies to mitigate the impact in water bodies, while improving plant N uptake and N use efficiency by studying different soil management techniques or the plant-soil interaction.
R32	Others	Science, Practicies and Policy Support	Public University of Navarre/Universidad Pública de Navarra	In-kind	150,000	**Mediterranean Case Study**: Focused on regulatory mechanisms of different plant processes, dealing with different aspects of nitrogen metabolism, and in applied aspects linked to agricultural management. Provides evidence on the use of δ15N for the study of the absorption of various forms and concentrations of N (primarily NH_4^+/NH_3) and its potential as a physiological indicator of NH_4^+/NH_3 use efficiency. Expertise in biological nitrogen fixation, which can be of added value in the context of global nitrogen management.
R33	Others	Science, Practicies and Policy Support	Research Center for Energy, Environment and Technology – CIEMAT Centro de Investigaciones Energética Ecotoxicology.	In-kind	450,000	**Mediterranean Case Study**: Effects of air pollution (ozone and N compounds) on Mediterranean vegetation and defining air pollutant threshold values (critical loads and levels) for the protection of vegetation. Expertise on atmospheric N deposition especially of dry deposition. Experience on the influence of climate change and air pollution on C, N and soil-plant-atmosphere interactions in Mediterranean forests ecosystems and crops.

Part-ner[40]	Sources of Co-financing	Category	Name of Co-financier	Type of Co-financing	Amount ($)[41]	Rational for partner inclusion / contribution
R34	Others	Science, Practicies and Policy Support	Basque Centre For Climate Change, Spain	In-kind	100,000	**Mediterranean Case Study:** Interested in the development and use of mathematical systems modelling approaches at different spatial scales (LCA, field, farm and landscape) in order to: (i) improve our understanding of the effect of agricultural/forestry production systems on the net contribution of CO_2, CH_4 and N_2O, (ii) study the potential for reduction of different strategies to reduce such GHG and (iii) evaluate the associated side-effects on other N reactive forms (e.g. NO_3^- leaching, NH_3 and NO_x) and ecosystem services.
R35	Others	Science, Practicies and Policy Support	University of the Basque Country, Spain	In-kind	150,000	**Mediterranean Case Study:** Focus on increasing nitrogen use efficiency (NUE) in agroforestry systems. From an environmental point of view we evaluate the impact of different nitrogen fertilization managements (e.g. nitrification inhibitors) on the emissions of greenhouse and nitrogen reactive gases to the atmosphere. Not only NUE but also safe food must be achieved at the same time, so the research group also studies the changes produced in the crop, focusing on the study of plant nitrogen metabolism.
R36	National Government	Policy Support	Ministry of Agriculture, Food and Environment - Spain	In-kind	90,900	**Mediterranean Case Study:** Spanish Ministry of Agriculture, Food and Environment is competent for calculating the nutrient budgets in the agriculture in Spain (since 1998). There is a group with representatives of agriculture, livestock, industry and university and scientific research centres, in order to update and improve the methodological criteria for the calculations. These data with input from the case studies may be used to inform future nitrogen policy developments to reduce pollution while improving agricultural production.
R37	Others	Supporting Demonstration	University of Reading, UK	In-kind	3,000,000	**Supporting UK Demonstration:** Research on the measurement, monitoring and assessment of catchment scale nitrogen and phosphorus pollution, drawing on datasets from key national 'Demonstration Test Catchments' (from the UK), and experience of implementing the Water Framework Directive, as a basis for contributing to the development of management options relevant to the full nitrogen cycle. (Rivers Avon, Wensom and Eden, UK, for which the costs are already fully covered through the UK Department for Environment, Food and Rural Affairs, Defra). Involvement of this fully funded activity within the INMS would allow sharing of expertise with other areas.
	Total Co-financing				**47,622,900**	

Annex 4 - Summary Status Report – Global Nutrient Foundations Project (GEF ID 4212)

UNEP/GEF: Global foundations for reducing nutrient enrichment and oxygen depletion from land based pollution, in support of Global Nutrient Cycle (Global Nutrient Foundations, or GNF)

June 2013

Background

The GNF project is one of the building blocks contributing to the baseline for the proposed project on the global nitrogen cycle towards an International Nitrogen Management System (INMS). The GNF project has a core objective '*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'*. A summary of the GNF achievements is included in section A1.2 (Baseline Scenarios and Projects) of the PIF, with this brief status report providing an overview of the progress of the four components.

Overall the GNF project is considered to be mostly on-track with the expectations of the Project Document although some contractual delays have been encountered in Component B (based on the project progress report – March 2013).

Component A: Global Partnership on Nutrient Management (GPNM) addressing causes and impacts of coastal nutrient over-enrichment and hypoxia

The GPNM is fully operational with its secretariat at UNEP. It now has the support of 64 governments and the European Commission. It has received the UNEP Governing Council's approval, and established regional platforms in Asia and the Caribbean, with another one in discussion for Africa (Output A.1). GPNM has a webpage nested in the GPA website (http://www.gpa.depiweb.org/gpnm.html) and a GPNM web-based platform is currently under construction (Output A.2). As part of the partnership communication strategy, the project has prepared a baseline document (**Foundations for Sustainable Nutrient Management),** and a project fact sheet (http://www.gpa.depiweb.org/docman/doc_download/36-gpnm-factsheet.html). The project has published six articles in newspapers, reports and journal papers. The project will hold special sessions at the 2nd Global Conference on Land-Ocean Connections (GLOC-2, Oct. 2013, Jamaica) and at the next INI conference (N2013, Nov. 2013, Kampala; see Output A.3).

The global overview on nutrient management (*Our Nutrient World: The Challenge to Produce More Food and Energy with Less Pollution*) has been produced with input from 50 scientists in 15 countries. This report has received wide media coverage globally and in the first 10 days of its publication saw 6000 downloads from the GPA website (Output A.4). A Synthesis Report identifying emerging issues and gaps is in progress (Output A.5).

Workspace for a Community of Practice for GEF nutrient projects has been launched through IW:LEARN. The discussion on agriculture extension services is in progress with the Agricultural Training Institute (ATI) Philippines (Output A.6). A special session, which included governments, industry, the science community and UN agencies, was organized during the GPA/IGR-3 in January 2012 in Manila (Output A.7). Meetings were held during the IW 6 Conference, with plans to hold a special session in the forthcoming IW Conference 7 (Output A.8).

Component B: Quantitative analysis of relationship between nutrient sources and impacts to guide decision making on policy and technological options

As part of the overview on existing tools for source-impact analysis of nutrients in Large Marine Ecosystems (LMEs), a literature review on river export modelling has been undertaken and a scientific paper published[43] (Output B.1). A global database on nutrient loadings and occurrences of HABs, hypoxia, and effects on fisheries is under development, including publishing a paper on finfish aquaculture[44] (Output B.2). Partners are engaged in the collection and analysing data for nutrient impact modelling at the global to local scale for nutrient source impact analysis (Output B.3). Data for modelling the nutrient impact to the Manila Bay demonstration area (facilitated by PEMSEA) is in progress and expert input is underway to select the appropriate model (Output B.4).

A first discussion among partners and experts of components B and C has been held to discuss the design of the Policy Toolbox (Output B.5). Project partners are screening potential candidates for training in using nutrient source-impact modelling/analysis (Output B.6), which will subsequently allow the development of nutrient source-impact guidelines and manuals for integrated eutrophication assessment and nutrient criteria (Output B.7).

The delay Component B noted above applies particularly to the work on the policy tool box and web platform, which has been delayed due to legal and administrative issues related to subcontracting.

Component C: Establishment of scientific, technological and policy options to improve coastal water quality policies in LMEs and national strategy development

A comprehensive inventory of 'best practices' in nutrient reduction has been prepared, consisting of 334 BMPs from 59 different countries (Output C.1). Three case studies on selected technology and policy options for nutrient over-enrichment reduction have been completed, with additional input expected on nutrient efficiency (Output C.2). A synthesis of technological and policy options is complete (Output C.3). The GNF will be presented at the IWC 7 (Output C.4).

Discussions are in progress on the use of the Policy Tool Box (Output C.5) and between experts on how to integrate the Tool Box with source-impact modelling (Component B) and analysis (Output C.6). The approach to practical application of these tools and the training of experts is preparation (Output C.7).

Component D: Development of nutrient reduction strategies through the application of quantitative source-impact modeling and best practices in the Manila Bay watershed

A workshop took place in August 2012 to develop and agree on a work plan for the integration of the databases of the three site management offices and two provinces (in addition to the existing Manila Bay database). A second workshop was held in September 2012 focusing on resolving redundancy issues and developing an action plan on the maintenance and updating the databases in the Manila Bay area regions. (Output D.1).

Expert groups have met with various government agencies, with the various good practices/lessons learned in nutrient management in the agricultural sector in the Manila Bay sector now being documented and summarized. A concept paper (Updating the Manila Bay Area Atlas and Manila Bay Risk Management) has been prepared (Output D.2).

[43] Bio-Geoscience: Nutrient Dynamics, Transfer and Retention along the Aquatic Continuum from Land to Ocean: Towards Integration of Ecological and Biogeochemical Models"

[44] Hindcast and Future Projections of Global Inland and Coastal Nitrogen and Phosphorus Loads Due to Finfish Aquaculture

To understand the dynamics of hypoxia and eutrophication in Manila Bay, a bay-wide survey of the bay was completed in August 2012. Results of analyses and research on dissolved organic carbon were presented at the Asia Oceana Geosciences Society (AOGS) and American Geophysical Union (AGU) Western Pacific Geophysics Meeting in Singapore (Output D.3). These activities support the development and adoption of integrated nutrient reduction strategies (Output D.4)

In the Lake Chillica (Orissa province, India) demonstration, two expert group meetings contributed to enhancing dialogue amongst policy makers, national agencies, and other project partners. Consensus was reached on key indicators for ecosystem health and their threshold values. It was agreed to release the first 'report card' designed to give an overview of ecosystem health. The report card was endorsed by the local stakeholders and policymakers, including the Chief Minister of the Odisha Government and his senior officials. It has since then been widely reported in national newspapers and local TV channels (Output D.5). The Laguna de Bay Authority attended the Chilika workshop in order to learn and contribute to the ecosystem nutrient health report card, and find a way to apply it to Lake Laguna and the Manila Bay in the Philippines (Output D.6)

The lessons from these specific case studies are being fed-back in to the dialogue of the GPNM to allow the fostering of the best practices for other regions, including development through the a wide range of GPNM national, private sector and NGO stakeholders.