'International Nitrogen Management System Pump Priming (INMSpp)'
Report of the First Workshop: May 5th and 6th, Edinburgh, 2015

Introduction

Mark Sutton provided an overview of the 'Towards an International Nitrogen Management System' project, including the preparation for proposal submission, the components and links to the INMS Pump Priming project (slides available at www.inms.international/inmspp/inmspp-and-tfiam-may-2015/sutton-toward-inms-edinburgh-intro-web-version.pdf). The following points were raised and discussed:

Project timescales: The INMSpp project started in 2014, however the INMS project is not estimated to begin until 2016. Outcomes from this meeting of the INMSpp project are intended to go into the INMS main project proposal. The challenge is to ensure that INMSpp is fully engaged with the INMS process. Communication is needed in both directions – INMSpp must engage with INMS on what is possible from the integrated assessment modelling community and the INMS project must communicate the modelling needs for a science-policy support process. As INMSpp will finish (2017) before the INMS project (estimated 2019), then it is also important that INMSpp deliver within its project timescale. It will be necessary to move forward in an iterative fashion, with a high level of communication between projects.

GEF funding model and overall budget breakdown: The GEF funding model was clarified. The project is incremental in nature, meaning that partners to the project 'pledge' co-financing from other projects which are working towards the aims of the INMS project. This co-financing can be for work on future projects and past projects which support such work (i.e. model development from the past 3 years).The current outline project budget (co-financing and GEF funds) by component is available in the 'Project Identification Form' on the INMS website [www.inms.international/documents/project-identification-form]. NB: Since the meeting a more detailed project activity, task and budget breakdown for the GEF funding component has been posted on the INMS website (www.inms.international/guidance-on-inms-proposal-documents/guidance-on-inms-proposal-documents).

International Waters – project focus: The GEF project will sit under the 'International Waters' focal area of work. The scope of the project is however global and multi-pollutant/compartmental in nature, i.e. we are looking at the whole nitrogen cycle and possible synergies for both water and atmospheric pollution, both in freshwater and ocean contexts.

Hans van Grinsven presented the first of the three background documents for the meeting, 'Prioritising Nitrogen Threats and Benefits: Which issues need to be linked when developing integrated modelling capability?*' (slides available at www.inms.international/inmspp/inmspp-and-

and background document available at). The following discussion points were raised:

Organic nitrogen forms: It was noted that we should not forget to include organic forms of nitrogen in our discussions as they play an important role in both the water and atmospheric aspects of the nitrogen story.

Clare Howard presented the second of the background documents, 'Policy Linkages: What are the priority measures needed for better nitrogen management that should be included in models?. The following points were mentioned in discussion (slides available at and background document available at).

How to prioritise measures? One approach is to start by thinking of the measures which are already at the top of our lists personally (i.e. like favourites), to start the ball rolling. Then we need to think of which measures can be of common benefit, i.e. for water and atmosphere. Maximising the synergies is important here. Also looking at the regional aspect will be important, whilst also considering all of the relevant sectors. We should consider not only technical measures, but other more innovative approaches where available and relevant. The data needs to implement such measures should also be considered.

Wim de Vries presented the third of the background documents, 'Issue/Compartmental Linkages: How should different Compartments of the nitrogen cycle be linked when formulating nitrogen integrated assessment models?'. The following points were mentioned in discussion (slides available at and background document available at).

Nitrogen Forms: It was noted that some models only predict nitrate and that we should not forget other nitrogen forms and assess whether the current models provide what we want.

Validation: This is an important consideration and if verification is already available this is very useful.

Marine modelling: A lot of estuarine models exist, but the marine side is not as well covered. However, the Global Enviroment Facility has funded a simple model for coastal-marine impacts.

IMAGE model: This model has several benefits for this kind of work, including the fact that is open source and not highly complex. There are potential plans to link it to an Earth System Model. Other models could also be linked to image to achieve what is needed.

Model needs: It is necessary in addressing the Nitrogen problem to have model(s) which nest and are able to address multiple scales, local to global. Interaction with climate and also costs of measures is required. One approach could be to have a full scale model which looks for the sensitivities and then use the output to assess cost optimization with the GAINS model. For climate the ARES global scenarios should be used.

Other items to include: The health impact of malnutrition is also important in this context and has been recently highlighted by other groups.

Working Groups & Feedback

Following the presentations, the participants split into 3 working groups, one on each topic. The results from their discussions were reported back in plenary the next morning, the information from their slides is inserted as an annex below and original slides are also available at www.inms.international/inmspp/inmspp-and-tfiam-may-2015/inmspp-edinburgh-workshop-presentations. Minutes from each group can also be downloaded at www.inms.international/inmspp/inmspp-and-tfiam-may-2015/inmspp-agenda-and-background-documents.

The conclusions from each group will be used to refine the three background documents, which can then be submitted for review and/or consultation to the relevant science or stakeholder groups.

WG1 Feedback Slides: 'Prioritising Nitrogen Threats and Benefits: Which issues need to be linked when developing integrated modelling capability?'

Aims
- To find an acceptable procedure to prioritise Nitrogen related issues
- Establish what this means for INMS modelling system

Criteria for selecting issues:
What additional modelling is required? Does INMS community have skills or are more partnerships required?
Opportunity to strengthen marine modelling
Need for stronger socio-economic modelling
       (food prices, farm income, land use, buying power)
- Start from a BAU-projection with current regulation (link with SSPs)
- Assess feasible additional measures regionally, both technical and behavioural measures
- Assess potential of new emerging technologies (NO_x recycling, artificial meat/dairy, ..)
- Assess economic, institutional and psychological barriers

Table 1: WG participants were asked to rank the priority in which issues should be communicated to policymakers on a scale of 1-7 (where 7 is most important).

	Water Quality	Air Quality	GHG Balance	Ecosystems Biodiversity	Soil Quality	Food Security	Energy Security
EU averages (expert view)	4.2	5.2	5.8	4.9	1.8	2	4.6
Asia (journalist view)	4	5.5 (makes a lot of news)	5.5	1 (only discussed by academics)	2	7	3
Africa (peoples view)	6 (do not have water treatment)	3 (local issues)	1 (seen as a problem for developed countries)	5 (people can see the changes)	4 (where you grow food, need to think ecosystem first)	7 (for Africans to listen he must mention food)	2 (public perception is low)

Missing issues that should be included in the WAGES_FE clusters:
- Depletion of nitrogen *(= add to "soils")*
- Ocean ecosystem services (fish, coral reefs, C-cycle) *(= add to "Water")*
- Nitrogen deposition related diseases (allergies, malaria,..) *(= add to "Ecosystems")*
- Unhealthy diets (obesity and other diseases linked to eating too much meat) *(add to food)*

WG2 Feedback Slides: 'Policy Linkages: What are the priority measures needed for better nitrogen management that should be included in models?

Discussion points
- Criteria for selecting measures
- Prioritizing criteria to select measures
- Selecting measures for modeling

Criteria for selecting measures
- Went through list in background document page 4
- Discussed need for and characteristics of each criteria
- Will develop a document of criteria details for review by INMS policy group
- Some examples

NUE - Very useful, but…
- o Need to define what it means, e.g. high NUE might indicate N deficiency for crop production
- o may not capture impact of chemical forms and pathways for loss
- o consider in context of other criteria - low improvements in NUE bu high applicability and implementation

Cost/Benefit Analysis
- Possibility to enforce or measure effectiveness
- Time to market
- Incorporate into current policy and politics
- Existence of co-benefits
- Importance of measures to different regions

Other criteria discussed
- Possibility to enforce or measure effectiveness
- Time to market
- Incorporate into current policy and politics
- Existence of co-benefits
- Importance of measures to different regions

How to prioritize criteria?
- Will need to be done, but general view to not prioritize too much
- Look for guidance from other international assessment efforts
  - o Measures with large potential impact
  - o Measures with past success
  - o Measures with co-benefits (win-win)

Selecting specific measures
- Not discussed fully - end of the day
- Figure and table in background document are good basis to start, especially globally
- Will have to be reviewed at regional scale
- Brief discussion of how to move between regional and global scales when assessing measures

Need to identify next steps
Prepare short document of criteria to select measures for review by policy stakeholders

WG3 Feedback Slides: 'Issue/Compartmental Linkages: How should different Compartments of the nitrogen cycle be linked when formulating nitrogen integrated assessment models?'

Four main questions were discussed

Questions tackled

- Which benefits and threats should be included in an INMS; Should we distinguish a detailed model system (for an elaborated evaluation of N management measures) versus a simplified system (to do cost-optimization)
- What global scale models are available, what are criteria to evaluate them for their potential use
- How can collaboration be organized within various modeling groups

What should be in the model system
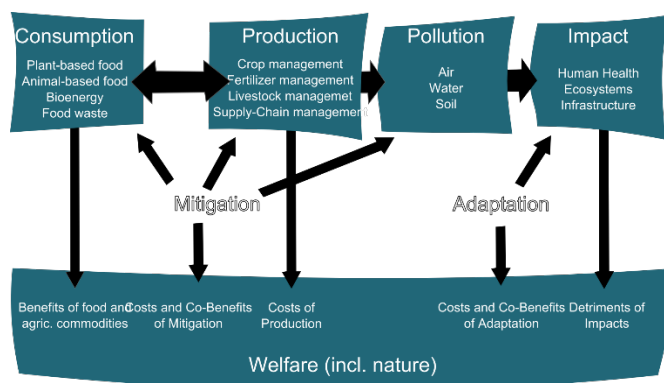
Distinction in various model systems

It was agreed that to evaluate policy options, we should

- have multiple approaches with cost-optimization being only one of them.
- look at cost effectiveness, with the target being a reduced threat or improved benefit or a combination of both of them

Available global scale models and criteria to evaluate their potential use

We will evaluate potential of available models, i.e.:

- *Scenario models* enabling the linkage between scenarios, consumption-production and nutrient inputs/air emissions and possible cost-benefit optimization: **Lex Bouwman**, Benjamin Bodirsky, Wilfried Winiwarter
- *Quality models:* assessing loads and concentration of nitrogen compounds (and other elements) in air soil and water: **Wim de Vries**, Penny Johnes, Dave Simpson, Claudia Staedner, Ying Zhang, Felipe Pacheo.
- *Impact models:* human health, productivity, climate, biodiversity etc. and related critical loads (regional N boundaries). **Wim de Vries,** Stefan Reis, Lex Bouwman, Penny Johnes, Baojing Gu, Benjamin Bodirsky.

Criteria to evaluate the models

- Model aim/Functionality
- Inputs considered: drivers of change
- Outputs considered: e.g. N forms, other elements etc.
- Biophysical representation

- Steady state vs dynamic
- Data needs
- Validity status
- Spatially resolution; Temporal resolution (and extent)
- Linkage to scenarios/measures
- Operational status, accessibility

Collaboration in N modeling community

Model development and data exchange

- We should not include/focus on development of new models unless an aspect is missing (model is really needed).
- We should focus on improving available models where needed not only within the modeling group itself but also by collaboration (new ideas outside the group).
- Data needs and data exchange is a crucial issue in the group

Model use

- There will be limited scenario models: their output should be used by multiple quality models and impact models
- If available: use more models and do a model intercomparison

Participant List

Participant	Organisation	Country
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