

Global foundations for reducing nutrient enrichment and oxygen depletion from land based pollution, in support of the





GPNM Phosphorus Task Team Inaugural Meeting

15-16 September 2015 Prepared by the GPNM Secretariat

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September 2015

About the GEF-Global Nutrient Cycle Project

Project 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.

Core project outcomes and outputs:

- the development and application of quantitative modeling 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
- the 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
- the application of the modeling 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 watershed with a view to helping deliver the key tangible outcome of the project – the development of stakeholder owned, cost-effective and policy relevant nutrient reduction strategies (containing relevant stress reduction and environmental quality indicators), which can be mainstreamed into broader planning
- a fully 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.

Project partners:

- Chilika Development Authority
- Energy Centre of the Netherlands
- Global Environment Technology Foundation
- Government of India Lake Chilika Development Authority
- Government of the Netherlands
- Government of the Philippines
- Government of the United States
- Intergovernmental Oceanographic Commission of UNESCO
- International Nitrogen Initiative
- Laguna Lake Development Authority
- Partnerships in Environmental Management for the Seas of East Asia
- Scientific Committee on Problems of the Environment
- University of Maryland
- University of the Philippines
- University of Utrecht
- Washington State University
- World Resources Institute

Implementing Agency: United Nations Environment Programme

Executing Agency: UNEP- Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA)

Global Partnership on Nutrient Management (GPNM) Inaugural meeting of the Phosphorus Task Team

Meeting Proceedings

15-16 September 2015 Centre for Ecology and Hydrology Edinburgh, Scotland

Supported under the

GEF-funded Global Foundations for Reducing Nutrient Enrichment and Oxygen Depletion from Land-Based Pollution, in Support of Global Nutrient Cycle (GEF-GNC) Project



September 2015







Background

The Global Partnership on Nutrient Management (GPNM) was launched in 2009 to address the global challenges faced by the mismanagement of nutrients and nutrient over-enrichment. It is a global partnership of governments, scientists, policy makers, private sector, NGOs and international organizations. It responds 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 more efficient and effective nitrogen and phosphorus use and lower losses associated with human activities. It provides a platform for governments, UN agencies, scientists and the private sector to forge a common agenda, mainstreaming best practices and integrated assessments, so that policy and investment responses/options 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 impact assessment work. The work of the GPNM is advanced by a Steering Committee, a sub-set of the Partnership members and is supported by the GPA Unit of the Marine and Coastal Ecosystems Branch of the Division of Environmental Policy Implementation of UNEP, which serves as the Secretariat to the Steering Committee.

At its December 2014 Steering Committee meeting, the GPNM mandated the establishment of a special Task Team to focus on the issues of phosphorus management, its use-efficiency and impacts to the environment. This Task Team is chaired by Arnoud Passenier, GPNM Steering Committee member, and the current President of the European Sustainable Phosphorus Partnership. The proposed objectives of the task team are:

- 1. To create a global, dynamic and forward thinking team of multi-stakeholder representatives to work towards a shared vision of phosphorus sustainability for the world.
- 2. To ensure the GPNM uses its established connections and expertise to foster innovation and enhance pilot and demonstration projects that can support better global management of phosphorus.
- 3. Promote an enabling environment and evidence base for governments and international and intergovernmental organisations that wish to become involved in implementing solutions that will deliver better global management of phosphorus.

The workshop was hosted by the Centre for Ecology and Hydrology (CEH) and the United Nations Environment Programme (UNEP). The meeting took place at the CEH in Edinburgh, Scotland over the 15th and 16th September 2015. The workshop agenda is contained in Annex 2.

The meeting was supported through financial contributions from the GEF-funded Global Foundations for Reducing Nutrient Enrichment and Oxygen Depletion from Land-Based Pollution, in Support of Global Nutrient Cycle (GEF-GNC) Project.

Meeting objective

To facilitate the establishment of a Phosphorus Task Team (PTT) of the GPNM to address the special issues of sustainable phosphorus management through its appropriate positioning within the GPNM and the global community, determination of core contributions of the PTT and definition of modalities for collaborative work of the PTT with stakeholders. The specific outcomes of the meeting were as follows:

- Define the role of the PTT;
- Outline milestones, outputs and deliverables of the PTT;
- Create a plan of action for the year ahead.

Day 1 Proceedings

Welcome remarks Arnoud Passenier of Ministry of Infrastructure and the Environment – Netherlands

Mr. Passenier officially welcomed participants who gave a brief introduction of themselves (the participant list in in Annex 3). He noted that the Phosphorus Task Team (PTT) will take up from the now concluded Global TraPs initiative and use the shared knowledge to apply best practices for phosphorus management. He expressed hope that the discussion will lead to articulation of a plan of action for the next two years in the context of what can be done within the GPNM related to phosphorus management. He noted that the GPNM has a task team on nutrient use efficiency which is mandated to consider all nutrients in a holistic manner. The key question for the PTT is what should be done on the global level and what will the road map look like for phosphorus management. There has to be a clear indication with whom we collaborate and who are the other stakeholders out there we need to engage with; all this needs to feed into the roadmap. Hence the three key considerations are:

- 1. What can we do; the plan of action;
- 2. What can be addressed on a global level;
- 3. With whom; specifically those stakeholders that need to be engaged as part of the global network.

Session 1: Viewpoints on Phosphorus Sustainability

Note: presentation slides are found in Annex 5.

Towards a Phosphorus-secure future: A review of Global Phosphorus Sustainability issues

Dr. Dana Cordell University of Technology, Sydney - Global Phosphorus Research Initiative (GPRI)

Dr. Cordell gave a review of the diverse challenges of phosphorus management. The issue may not be about resource depletion but rather about use efficiency. There are important geopolitical risks to be considered in phosphorus security in that the mineral resource is concentrated in a few countries. Clarity is needed around who needs to be involved in the phosphorus management framework; there may be sectors that are not currently engaged that need to be included. There is need to think about food and nutritional security which is very sensitive to phosphorus supply and noted that the system is quite dynamic with many factors related to fertilizer access. There are many collective goals that hinge on phosphorus security such as maintaining livelihoods, maintaining soil fertility, integrity of ecosystems and food security. The key consideration is how do we approach the issue of phosphorus security at the lowest cost to society? She compared the case of Australia that has naturally phosphorus-deficient soils where there is significant investment in intensive agricultural production with careful focus on phosphorus management, to Malawi, a country with less intensive agriculture and where phosphorus inputs are largely by manure inputs with negative consequences in terms of pollution. These cases underscore the need for different approaches depending on the local conditions.

She gave examples of opportunities for nutrient (and phosphorus) use efficiency. There have been efforts at engaging urban planners in Hanoi, Vietnam to optimize landscape management with favorable outcomes for sustainable nutrient management. She outlined the principles of sustainable change models in respect to sustainable phosphorus futures and presented a series of proposed phosphorus vulnerability indicators. She provided an overview of a systems approach toolbox for supply and demand for food security and environmental goals, outlining the considerations associated with production costs which have either direct or indirect social costs/externalities. There is a tendency not to consider externalities in sustainability costs. She highlighted possible interventions for mitigative measures and approaches for managing risks around market/policy socio-technical options.

Questions and discussion comments:

- **Q:** How might one consider all the relevant factors in a phosphorus balance sheet or model?
 - **R:** Advised to take a risk management approach rather than trying to put a dollar value on all factors. However, there would be difficulties in incorporating the externalities based on present knowledge gaps; case in point how to adequately factor in the ecosystem cycling.
- Fertilization in many places has resulted in phosphorus storage in soils and not necessarily lost from the system; it rather remains as a 'bank' or reserve. Phosphorus will be lost if there is erosion and this material is carried away by water. It is agreed however that there needs to be further research on how P is working in soils.

Phosphorus Vulnerability and Tools for Sustainable P Management

Dr. Tina-Simone Schmid Neset, Linkoping University

Dr. Schmid Neset outlined the approaches for a sustainability framework and vulnerability assessment. There are three factors to consider; (i) exposure, (ii) sensitivity and (iii) adaptive capacity, which works at the national level and allow for comparison between countries and regions. She further outlined some of the various methodologies for assessing vulnerability which includes approaches such as multi-criteria weighing. There is need to address the challenge of linking the research on phosphorus from the micro to the meso scale. Work is emerging on phosphorus foot-printing and presented an example from Brazil based on a similar approach for water-foot printing. She discussed the approaches for knowledge brokerage; how to build the bridge between science and policy, and illustrated an interactive decision support modelling tool for phosphorus demand and supply at the global level.

Questions and discussion comments:

- **Q:** What have been the results from the work on the modelling?
 - **R:** This is still relatively new and under validation. In Sweden where these tools have been introduced, there has been some lag in their uptake and adoption. Switzerland has made some progress in crafting policy for phosphorus recovery, which is planned to become mandatory by 1.1.2016 (10-year transition period)
- There is continuing debate and lack of consensus around how phosphorus scarcity is framed and how its meaning is interpreted. This is very important when it comes to communicating the issue to stakeholders. Originally the issue was framed in the context of depletion of the physical stocks (the rock assets), but there are always great uncertainties about the known and unknown reserves and resources, so it is better to discuss the access to phosphates (because of market deficiencies or political instability). It needs to be made clear that there are many other dimensions that need to be considered that define scarcity and sustainability of use.

Policy and Governance Opportunities and barriers for enhancing phosphorus sustainability

Arnoud Passenier - Ministry of Environment, Netherlands

Mr. Passenier presented perspectives of government and the challenges of merging the different political cultures of governments in the world (e.g. a more legalistic or non-legalistic approach), the interface between (regional or national) governments and the science interface around the phosphorus issue. In general, politicians only adopt an active policy if they agree not only on the urgency or severity of the issue involved, but also receive perspectives how to deal with the issue. Governments and the political leadership adopt in general risk-averse stances in decision making if it is perceived that there may arise problems in advancing policy that may have negative outcomes from the viewpoint of stakeholders. At least, we need to ensure that we have a common language to communicate to policy makers in assisting them to embrace the desired policy agenda. He acknowledged the different perspectives stakeholders will typically hold and the importance of effectively communicating the right message. He underscored the relevance of the Phosphorus Task

Team of the GPNM in conveying to the world how it can effectively influence policy around the issue.

Questions and discussion comments:

- Political solutions can be found in regulation, but sometimes we can find win-wins by putting together stakeholders in product value chains in a multi-stakeholder dialogue to let the network do the job.
- **Q:** How do we get more governments take an active role in the GPNM Platform in general and the P Task Team in particular?
 - R: At the global level, we could engage more regional platforms (e.g. in South-East Asia) but it would be great if government officials from China and India could get involved in GPNM/PTT

Phosphate Sector Supply challenges and Trends

Michel Prud'homme - International Fertilizer Industry Association (IFA)

Mr. Prud'homme, highlighting the elements of the phosphorus cycle underscored some of the issues raised by the other presenters on what needs to be done in terms of addressing the gaps in the P management agenda. He noted supply management among the range of issues across the phosphorus sector value chain. There are more than 1,000 producers/stakeholders in the sector with many peculiarities and operating at various economies of scales. The sector is highly fragmented so there is no "single voice" of the industry. He provided insights on P production and suggested that the reporting of phosphorus reserves is related to knowledge availability, referring to the wide variety in the data on supply reserves just between two years; 2009 and 2010. He also provided data on phosphate rock potential supply production. In recent years technologies have been developed that allow for use of lower-grade deposits to yield phosphorus fertilizer; this development therefore changes the P availability also. He noted that there are possibilities for recycling of co-products such as phosphogypsum for use. However, there are stockpiles of this material accumulating in some countries because there is no incentive to recycle. Brazil and China are noted to have policies introduced to encourage use of phosphogypsum (China mandatory). IFA acknowledges over-application and mismanagement, which can and should be addressed through a holistic approach.

Questions and discussion comments:

- Phosphoric acid production results in the production of phosphogypsum which can be used as a soil ameliorant. This alternative is useful when there are sulphur deficiencies in the soil. In India this product is being used. It can also be used for construction and the cement industry. China has significant recycling programmes for use of this material.
- Q: Has the US developed regulations on use of phosphogypsum?
 - **R:** This is yet to happen.
- It should be noted that there are site-specific feasibility issues regarding use of phosphogypsum that need to be taken into account.
- There needs to be better understanding of the market on a macro-level to advocate for suitable incentives to encourage the sustainable use of phosphorus; however not with intent to interfere with market positions of individual companies.

Opportunities and Barriers for Enhancing P Sustainability

Dr. Tom Bruulsema - International Plant Nutrition Institute (IPNI)

Dr. Bruulsema gave an overview of IPNI and its role at the global level. He highlighted the soil test results for phosphorus across North America noting that the soils are variable and how this factor needs to be considered in demand. He provided an overview of phosphorus input to output across the US and the cropland phosphorus balances, noting opportunities to more efficiently use phosphorus. He emphasized the importance of the 4R approach (right source, rate, place, time) to fertilizer management to protect water quality, noting that other agronomic techniques such as conservation tillage are also important. There are huge opportunities to better utilize the phosphorus in manure. Innovative technologies to transport (treated) manure are very important. Placement and timing are very important to prevent eutrophication. A key barrier to improving the recycling of phosphorus is economics.

Questions and discussion comments:

- **Q:** What does the picture look like in terms of soil testing at the global level?
 - R: The level of sampling soil as exists for North America is just not practical for many parts of the world and as a result there are gaps in knowledge. Dr. Shen noted that in China, there is a mandatory soil testing programme in the north-eastern part of the country so there are data in that region.
- **Q:** How is it possible that there are high occurrences of algal blooms in some lakes where the sampling data shows that the phosphorus loading is low?
 - **R:** This phenomenon could be possibly attributed to the influence of temperature regimes that are enhanced/driven by climate change; the P loading threshold that may trigger algal blooms may therefore be lower, although it must be recognized that there are other interacting factors to be considered. There is need to better understand the drivers.

The European Sustainable Phosphorus Platform (ESPP); successes, challenges and barriers

Chris Thornton – European Sustainable Phosphorus Platform (ESPP)

Mr. Thornton highlighted the wide scope of stakeholder engagement on the phosphorus agenda. He pointed out that the stakeholders range from industry to utilities to governments to feed/fertilizer companies. However, what has been lacking to date is engagement of the downstream food industry stakeholders. Over the past two years, a platform has started to be built in Europe building on actions already underway in Netherlands, Flanders, and the Baltic. There are many initiatives in progress or on the way that provide opportunities for networking around the issue. He noted however, that there is need to introduce proper network management tools to manage this broad process. He outlined some of the tools already being used by the ESPP including various communication outreach products, the website and the SCOPE Newsletter.

The platform provides input to policy makers in areas that include environment protection, water and nutrient recycling, progress toward the circular economy framework in the context of sustainable use of bio-nutrients. The platform also supports the consultative process to support the regulatory development process and provides a way to reach stakeholders and coordinate positions. An important role of the platform is providing supporting data and shared insights in issues and innovations for policy making. He acknowledged that there has been a challenge in engaging downstream users, notably the food supply sector. Activities should be linked to the SDG-goals set, particularly the SDGs on hunger and agriculture (Goal 2), water (Goal 6), sustainable consumption and production (Goal 12), and on oceans (Goal 14). Attention should also be paid to the linkage with SGD Goal 3 on health.

Sessions 2 & 3: The Role of the Phosphorus Task Team globally and within the GPNM

The next sessions were facilitated by Dr. Christopher Cox around an open discussion on a series of questions that would contribute to clarity on defining the role and contributions of the task team in the context of the global setting and within the GPNM itself. The following were the key points of agreement among the participants:

- The PTT can play an important role in supporting the GPNM and the GPA in their mandates. The role is to address the right issues, to influence networks on putting those issues on the political and research agendas, create a shared vision on future sustainable use of phosphorus and enhance knowledge dissemination about sustainable innovations. The PTT does not execute research by itself, as GPNM itself doesn't execute research. The PTT should build upon existing knowledge, and influence stakeholders to integrate objective knowledge and insights into the political and business arena;
- The PTT's mandate may be structured around four guiding themes/pillars:
 - i. Securing sustainable access to phosphorus fertilizers,
 - ii. Promoting healthy diets for the global population,
 - iii. Promoting soil health/fertility and productive agriculture, and
 - iv. Promoting the health of rivers, lakes and oceans.
- We need to rely on existing networks first and not duplicate, but rather enhance the coordination and networking (between regional platforms, with scientific platforms) at a global level;
- There is a need to clearly identify possible strategic partners based on recognized gaps. Other sectors like tourism, food industry, nutritionists should be included;
- The P management agenda (from mine to field to fork) can be nested within the GPA mandate given relevance to nutrient loading to the oceans. This is an important leverage that UNEP has to contribute to the issue. This may also be connected to the United Nations Environment Assembly (UNEA) and advancing global positions by countries;
- It is important to consider the linkages to the Sustainable Development Goals (SDGs, esp Goal 12); but also on hunger and agriculture (2), 6 (water), 14 (oceans) and health (3) it is important to also note that the issue will not only have a pollution focus;
- The role of PTT is not to execute research and studies ourselves, but to address the most important issues on the political, business and science level: putting issues on the agenda, creating a shared vision and a shared language for the future, delivering the right

information to make political and research decisions and to disseminate the most relevant knowledge globally;

- Phosphorus supply security (global depletion of resources) is a long-term issue which should be addressed, engaging relevant industries and geological experts in the world in the context of sustainable access to phosphorus fertilizers in order to get transparent and independent data, to develop a strategy for consistent stock assessments. At the same time, the access to phosphorus is dependent on other elements, such as high prices because of transport costs, corruption, etc.;
- Phosphorus management must be integrated within wider nutrient use efficiency concepts. What concepts from nitrogen use efficiency can we adopt for P use efficiency? There has to be a good system of understanding towards development of a common model; economic modeling from the Global Traps initiative may be considered. This issue can be addressed within the NUE TaskTeam;
- Further work may be contributed to better understanding the phosphorus flows and budget including changes over time and full-cycle P management; a dedicated publication for P following a similar approach as presented in the GPNM *Our Nutrient World* (2013) publication may be something the PTT may consider;
- The PTT may also provide support to the development of global indicators for the food industry, with their engagement that would assist governments to implement appropriate policy in the scope of a global movement;
- It is important to realize that there will be unique issues for phosphorus and "map on" to other areas and ensure there is no isolation from other wider issues (e.g. the role of micronutrients). It should be noted however that solutions optimal for P management may not apply or be optimal for nitrogen management. The role of the GPNM is important in facilitating integration;
- Work of the PTT needs to be linked to the soils management group and contribute to, and gain from the global soil monitoring system, particularly in terms of methodological approaches for P assessment, links to soil erosion and soil organic carbon;
- Livestock/meat production is a significant driver of P use and considerations could be given to societal choices in terms of consumption patterns. This part of the issue should be taken into account; what options may be available?
- The P budget approach (material flows) will allow for assessment of the relationship between what is mined, what is actually consumed, where excess winds up. This budgeting will support decision making and allows us to determine when along the cycle and how to respond.

DAY 2 Proceedings

Session 4: Defining Milestones, Deliverables and Outputs

Dr. Will Brownlie of the Centre for Ecology and Hydrology (CEH) provided an overview of the previous day's discussions on the direction of the Phosphorus Task Team based on the core pillars for phosphorus security; (i) access to phosphorus fertilizers; (ii) healthy diets for the global population; (iii) maintaining soils fertility and agricultural productivity and (iv) health of rivers and oceans. It was agreed that these four pillars seem to be positioned at a vision statement level and should form the basis of a **Plan of Action** for the PTT. These cover the importance of P in agriculture, food security, soil and freshwater quality. There are many possible pathways towards these four goals. One important sustainable pathway highlighted by the group was the circular (P) economy and improve/secure access of phosphate for the agricultural and chemical sectors.

It was noted that there seems to be quite a bit of discussion among scientists about legacy phosphorus; that is phosphorus stored in soils. However, there are gaps in terms of how to proceed with policy development. There does not seem to be much in the way of advancing toward a "circular" economy with P management and this is the direction in which the P agenda must move. The human health dimension also needs to be kept in the discussion. There are emerging concerns on P intake and associated health impacts but the relationships are not very well understood. The macro-economic dimensions of the P agenda needs continued work as well.

The meeting deliberated on the key priority areas that should form the basis of a Plan of Action that will support the global phosphorus management agenda. The following are the key actions the PTT is positioned to address (within the context of the aforementioned role of PTT):

- 1. Provide internal support to the GPNM and other Task Teams;
- 2. Find champions and support their roles on the P issue. Need to think of the key messages that need to get out
- 3. Support the conduct of an evaluation of key phosphorus management approaches applicable to various world regions, how applied, determine the gaps and identify areas for improvement. This may be a short-term objective of the PTT. Soil erosion and P losses to the environment, particularly in the context of nutrient pollution to the marine environment may be another useful area to give attention; seems to be more research required in this area;
- 4. Contribute to assessing P soil stocks and understanding the dynamics; assess P interactions with micronutrients. Assess synergies and co-benefits of P management with other global cycles (N, K, C);
- 5. Investigate options to optimize bioavailability of P stocks locked in soils (soil P banks);
- 6. Advocate for use efficiency to the policy (political) agenda; provide support for decision and policy makers (at the scientific-policy interface);
- 7. Contribute to improving mechanisms to access P data (between countries and industries);
- Promote inclusion of better P management within the SDG, (Goal 14 > Goal 14.1 re water pollution, and Goal 2 > 2.3 re food security, agricultural productivity and access to resources): <u>https://sustainabledevelopment.un.org/topics;</u>

- 9. Foster better understanding of P in health. This is an emerging issue on the science front; still to be considered by the mainstream medical fraternity. The issue remains on the margins of the nexus between environmental science and medicine;
- 10. Address the issue of feed additives and relationship to food consumption and diets;
- 11. Contribute to better understanding of the economics of phosphorus and theory drivers in relation to access and use by farmers;
- 12. Contribute to the agreement and development of appropriate indicators (i.e. sustainability indicators for industry, global/national indicators to demonstrate improvements, successes and sustainability impacts) and data needs and management towards development of decision tools for P management;
- Develop a 'suite of policy options' for governments/stakeholders that outline 'quantified benefits' of committing to a particular combination of policy options to reduce a region's P vulnerability. This could build from existing tools, such as the interactive scenarios: <u>http://phosphorusfutures.net/interactive-future-phosphorus-scenarios/</u>;
- 14. Foster the development of appropriate P assessment approaches for water bodies and measures to account for impacts and losses associated with soil erosion. Investigate options to reclaim P from eutrophic waterbodies;
- 15. Advocate for assessment of full chain efficiencies and P footprint approaches (identify data gaps);
- 16. Facilitate knowledge transfer between stakeholders and governments (including the wider community).

Session 5: Stakeholders, Team Members and the Planning the Way Forward

This session was an open plenary. The GPNM Secretariat facilitated discussion on a proposed process in engaging partners in moving forward.

There was a discussion on the how to approach global leadership and championing the P management agenda. It was agreed that the role of nutrients must be elevated to the top global agendas and frameworks such at the level of World Water Forum. The example of the championship approaches adopted by the World Water Forum was highlighted; there were key players/champions who drove the issues contributing to the success of the Forum. Leadership was shown from the top, which significantly contributed to moving the agenda, however, not to diminish the bottom-up approach. The issue of nutrient management similarly draws on the critical dimensions related to water. Potential opportunities to insert the nutrient management agenda include the OECD and European Union Ministerial conferences.

Additional stakeholders the PTT should engage with (i.e. those not represented at the meeting):

- Tourism (i.e. impacts to environments from eutrophication)
- Medical Profession/Nutritionists
- Geologists
- Mining industry
- Food industry
- More national governments.

The importance of individual connection and empowerment of 'champions' to engage with new stakeholders was highlighted (and illustrated with a P recycling project in Malawi).

It is noted that the role of the PPT is to facilitate stakeholder dialogue to define common assessments and proposals, incite action (among funding organisations, regulators, industry, R&D institutes) and disseminate results (e.g. case studies). While it is not the PTT's role to carry out research projects the PTT may foster the production of scientific content via individual or collective members and associates.

Based on the foregoing discussions the work of the PTT may be formulated around the following (a) short-term and (b) longer-term goals:

(A) Short term goals:

- Identify benefits for stakeholders to engage with the PTT and engage with them;
- Distil, translate and repackage current knowledge into engaging material to activate stakeholders and the public;
- Produce a special annex of equivalent "Our Nutrient World" (Sutton et al., 2013) which focuses on Phosphorus (to include an update to the conceptual P flows model as seen in "Our Nutrient World" page 23) (See Action Plan below for material that may be relevant for inclusion in such a document).
- Promote an "Our Nutrient World: P Issue" at "The first circular for 5th Sustainable Phosphorus Summit" in Kunming (August 2016). Use to engage with UNEA.

(B) Long term goals to include:

- Support the global assessment of nutrient linkages, benefits and threats;
- Investigate practice options, agree indicators and set targets for improved P management;
- Quantify the multiple benefits of meeting the targets: including how these support other global policies and targets;
- Monitor time-bound achievement of the targets, increase visibility of successes;
- Address barriers to change, fostering education, stakeholder discourse and public awareness;
- Provide a 'suite of policy options' for decision makers that is diverse enough to cover the specific needs and resources of each region, whilst highlighting quantifiable benefits of their commitment for change.

Dr. Cordell provided insights of the North American Partnership for Phosphorus Sustainability. Mr. Passenier acknowledged the keen interest of the World Resources Institute (WRI) in participating on the PTT. An expression of interest from WRI is contained in Annex 4.

Summarizing the next steps and the way ahead

The meeting Chair, Mr. Passenier stated that this first meeting laid the basis for a good start and thanked all for participation. The meeting was deemed by participants to have met its objectives with a key outcome being the arrival at a general consensus on how to lead a concerted approach among the global leaders on the P management issue.

The meeting agreed that there should be four main pillars around which the P management agenda for the PTT can be built:

- 1. Securing sustainable access to phosphorus fertilizers
- 2. Promoting healthy diets for the global population
- 3. Promoting soil health/fertility and productive agriculture
- 4. Promoting the health of rivers, lakes and oceans and reducing wastage in the whole value chain.

The following key actions were approved:

- Chris Cox, Will Brownlie and Arnoud Passenier will draft a Terms of Reference to define the scope of the Task team and modes for collaboration. The proceedings and the recommendations will be presented to the GPNM Steering Committee on the 5th of October 2015. A consultation process will be organized to complete the list of possible actions and set the right priorities.
- 2. The PTT will comprise of specialists working on specific technical and policy issues on the P agenda; the Steering Committee of the GPNM will be the strategic body that will action the work of the PTT at the global level.
- 3. Will Brownlie (along with Bryan Spears) of the Centre for Ecology and Hydrology will lead a small drafting team to develop an 'Action Planning matrix'. The following criteria are to inform the priority activities to be contained in the action plan:
 - Must address the four pillars;
 - Fills an important gap rather than duplicating existing work;
 - Be consistent with the GPNM framework, GPNM Steering Committee defined objectives and other GPNM Task Teams;
 - Enable the identification of gaps, barriers, opportunities and priority recommendations.

The Action Plan must clearly define:

- *'what'* identify the critical issues,
- 'why' establish the relevance of the interventions,
- 'what-how' define the results and expected outputs,
- *'who'* identify who will take responsibility for executing the actions,
- *'when'* specify the anticipated timeframe for achievement.

The Plan of Action should be completed by the end of November 2015 in time for the next faceto-face meeting of the GPNM Steering Committee. An initial brainstorming of the drafting team on the core elements of the Plan of Action is contained as a draft proposal in Annex 1 of this report.

- 4. Some specific directives that should guide the work of the PTT include:
 - Heighten the visibility of the P issue in the country context (e.g. use the United Nations Environment Assembly UNEA, as a forum to present a resolution on the issue and/or host a side event. The next UNEA is scheduled for May 2016);
 - Identify champions that would lead global advocacy on the P issue;
 - Design and implement the work of the task team within the frame of circular economy to build and link to the narrative on phosphorus;
 - Establish linkages with possible financing sources; use the UNEP-GPA mechanism to evaluate and access funding opportunities such as from the Global Environment Facility;
 - Plan for a combined event of the PTT within the 5th Sustainable Phosphorus Summit 2016, Kunming, China (16th - 20th August, 2016)¹;
 - Make the work and deliverables of the PTT relevant to stakeholders (e.g. business and governments) and their needs, in such a context that they are willing to invest in the GPNM/PTT (seeing benefits of a useful network and getting the right information to support decision making).

UNEP GPA concluded by stating that it will continue to support the work of the P Task Team in its role as Secretariat to the GPNM.

The afternoon session was a field trip to the Linlithgow Palace and adjacent Linlithgow Loch that has had a history of phosphorus loading into the lake. Dr. Spears provided insights on the issues of land management and contributors to P loading and initiatives aimed at mitigating further contributions. More information on the catchment management strategy of the Loch is provided in the report *Linlithgow Loch Catchment Management Plan - A plan for the improvement of water quality and biodiversity* at http://www.westlothian.gov.uk/media/7035/Linlithgow-Loch-Catchment-Plan/pdf/Linlithgow_Loch Catchment Management Plan.pdf

¹ <u>http://phosphorusfutures.net/announced-5th-sustainable-phosphorus-summit-to-take-place-in-kunming-china-august-2016/</u>



Meeting participants

Annex 1: GPNM-Phosphorus	Task Team workplan elements ((initial draft – for completion)
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WHAT	WHV	OUTPUTS CONM POT	OUTPUTS third	Collaborators	Timeframe	Costs
WIIAI	WIII		GPNM PPT	Conaborators	Timenanie	Costs
1. Indicators, models and transparent data a) A common conceptual model of P flows b) Update on P stocks and flows at global scale c) sustainability indicators for industry, indicators to demonstrate improvements and success, d) indicators of phosphorus vulnerability and sustainability to inform policy and research;	There are numerous global P flow models emerging and it would be highly beneficial to consolidate and produce one trustworthy/credible model that the global P community can use to inform future research and policy. This can provide decision-support for policy-makers, industry, researchers. Full chain footprint to understand gaps in knowledge quantify losses and efficiencies and provide context for decision makers and governments to engage in change. There is an urgent need to fill the gap in comprehensive, transparent, independent data sets related to phosphorus vulnerability and sustainability. Such indicators could provide evidence of vulnerabilities, stimulate targeted action, raise awareness, and evaluate	 Dialogue with stakeholders to define a common model, including shared definitions of losses, efficiency etc. Policy report to inform management practices and effective policy instruments. Expert Panel for validation of indicators; visually-engaging online indicators for annual tracking (similar to global water, climate, food security indicators) – wide-ranging sustainability dimensions from dependence on imports, price, market concentration, eutrophication potential etc. Engage with ISO, US standards (CEN SABE already underway in EU) and industry indicator organisation (TSC, FtF) and with stakeholders (including food industry) to develop shared indicator approaches 	GPNM PPT Policy paper to highlight gaps in knowledge Scientific project proposal to develop data and disseminate results			
	interventions.					

WHAT	WHY	OUTPUTS GPNM PPT	OUTPUTS third parties promoted by GPNM PPT	Collaborators	Timeframe	Costs
2. P and Diets a) Quantify changes in societal behaviour that can reduce P requirements b) provide a P foot-printing methodology for foods and food production types c) Assess the impact food waste has on P demand for different regions d) Assess health risk associated with high P content of diets, and impacts to different global communities	A dietary choice is one of the biggest drivers of global phosphorus demand (e.g changing preferences in India and China). Enable society to engage in a movement towards lowering societal P requirements through dietary and lifestyle choices To provide guidance to decision and policy makers on increasing use of P additives in foods. Emerging studies suggest excess P consumption (linked to food additives) can contribute to kidney and other disease in vulnerable people.	 Engage with farmers, food industry, "fast food" industry, other groups working on 'environmental impacts' of meat consumption, kidney patients' associations, environmental NGOs, organic food associations etc. Try to agree areas where further research or action is needed. EFSA just published an Opinion in Europe GPNM is not competent to do better 	Collate existing literature and publications on these different areas into a scientific assessment covering both approaches (health, P- footprint): NOTE CRC book currently underway			
3. P accessibility for farmers a) Drivers & mechanisms for lack of access, policy implications; b) National and catchment scale size projects to recycle existing P domestic supply in regions with: high dependence on imported P fertilizers, high farm-gate prices and that lack infrastructure and resources to secure P fertilizer c) identify champions in this regard (i.e. Malawi project) c) provide guidance on best practice	Importance of visible projects GEF funding is potentially more focused on higher productivity and lower environmental footprint through precession management. Successful project can provide "demonstrations areas" to encourage upscaling/national adoption	Case-studies of model small scale projects, dissemination	Collective agenda to develop proposals for funding for projects			

			OUTPUTS third			
WHAT	WHY	OUTPUTS GPNM PPT	parties promoted by	Collaborators	Timeframe	Costs
			GPNM PPT			
4. P in the environment	Acknowledging P locked in soils	Policy briefing	Scientific paper to			
a) improve 1. understanding of	as a huge potential resource (soil	~	highlight gaps in			
P legacy potential in different	P bank), that can be unlocked as a	Case studies – dissemination	knowledge			
parts of the world and 2.	source of bioavailable P to plants.					
potential to access significant			Work with other			
P stocks in soil, also	Informs innovation & technology,		groups already doing			
associated with historical	decision-making to support		this (e.g. P-RCN and			
over-application (in some	farmers (e.g. directly and via		WRI)			
regions, e.g. N America, W	extension services), and policy-					
Europe, parts of Asia), while	makers					
managing the risk of P loss to						
water; b) optimizing	Address future concerns of					
bioavailability of P in soils (in	potential impacts of P stores on					
both regions in surplus and	global water quality, in terms of					
deficiency) b) Quantification	economics, health risks, water					
of the global impacts of	conflicts and climate change					
eutrophication resulting from						
P over use c) identification of	Public awareness increasing in					
global areas of high risk d)	US (i.e. Lake Eerie, Everglades					
review leading technologies	and California Water shortages)					
and innovations to reduce P	_					
loading to waterbodies (i.e.						
sanitation in developing						
countries) and to						
harvest/extract P from						
eutrophicated waterbodies d)						
improve understanding of						
recycling potential of different						
P pools in the environment						
(quantifications)						

			OUTPUTS third			
WHAT	WHY	OUTPUTS GPNM PPT	parties promoted by	Collaborators	Timeframe	Costs
			GPNM PPT			
5. Technologies and Policy	There is a whole toolbox of	Policy Report: A 'Suite of Policy Options'	A tool to allow			
Options	existing and emerging sustainable	documentation	decision makers to			
a) Review leading and step	P technologies & innovations		quantify the net			
change technologies that may	which could be up-scaled and/or		impacts of choosing			
be ''main-streamed' to	implemented. However there is a		different options			
improve P use efficiencies for	need to identify which are the					
different regions b) identifying	lowest hanging fruit in each					
barriers imposing the main	context. Further, technologies and					
streaming of such technologies	innovations may be blocked by a					
c) Provide "choices" (a menu	whole range of barriers, such as					
of policy options) for how	historic legislation (i.e. issues					
governments can reduce P	with P reclamation from wastes,					
requirements/use and achieve	use of phosphogypsum).					
P security; options must be						
varied enough to give decision	There is also a whole toolbox of					
makers a choice in how they	policy interventions and options					
feel they can meet the	available, however importantly,					
different needs, resources, P	there is a need to identify the					
efficiencies and sufficiency's	appropriate suite for a given					
of their region d)	country or region to avoid					
Development of a framework	investing in inappropriate or					
to identify top 10 (?)	ineffective solutions.					
recommendations on reducing						
P vulnerability specific to	Findings can inform a 'Suite of					
region (i.e. context matters)	Policy Options' documentation					
	Input into the United Nation					
	Environment Assembly (UNEA)					
	Support GPA					

			OUTPUTS third			
WHAT	WHY	OUTPUTS GPNM PPT	parties promoted by GPNM PPT	Collaborators	Timeframe	Costs
6. Preparing for Future PR supply risk Potential risks to global P demand from a) step change technologies that may require P from PR (i.e. Bioenergy, P containing car batteries, etc). b) Security of supply (reducing vulnerability) because of instable or disputed regions. Dealing with population and economic growth and increasing meat consumption d) climate change and synergies and co benefits of better P management for other global cycles (micronutrients, N, C, K etc.) e) establish long term knowledge-anchoring mechanisms and policies	Instigate discussions on what are the future risks and prioritise actions to address them Support decision and policy makers	Policy Report	Scientific Paper			

Annex 2 - Workshop Agenda

GPNM Phosphorus Task Team Inaugural Meeting 15-16 September 2015 Venue – Centre of Ecology and Hydrology in Edinburgh, UK

Time	Session	Detail / Objectives	Lead Resource person(s)
DAY 1: 15 th	September, 20	15	
9:00 - 9:10	Opening remarks	Welcome and Introductions	Arnoud Passenier
Session 1:	Viewpoints on	Phosphorus Sustainability	
9:10 - 9:30	Participants	A review of the global issues on P sustainability (15 mins + 5 mins discussion)	Dana Cordell
9:30 - 9:50	IntroductionsPhosphorus vulnerability and synergies with other sustainable development goals (15 mins + 5 mins discussion)		Tina-Simone Schmid Neset
9:50 - 10:10		BREAK	
10:10 - 10:30		Policy and governance opportunities and barriers for enhancing P sustainability (15 mins + 5 mins discussion)	Arnoud Passenier
10:30 - 10:50	Participants Introductions	A viewpoint from industry on the opportunities and barriers for enhancing P sustainability (*provisional title) (15 mins informal briefing + 5 mins discussion)	Michel Prud'Homme
10:50 - 11:10	0 The European Sustainable Phosphorus Platform (ESPP); successes, challenges and barriers (15 mins + 5 mins discussion)		Chris Thornton
Time	Session	Detail / Objectives	Lead Resource person(s)
Session 2a	: The Role of th	ne Phosphorus Task Team	
11:10 - 12:30	Group Discussion	 Questions for discussion: What support does the global community need in order to reduce phosphorus vulnerability? How do the issues surrounding P resource use differ between geographic regions and how can we ensure our role serves the needs of all regions? (i.e. not just those regions using excess P) What is the role of the PTT in supporting the different 	Chaired: Chris Cox

Time	Session	Detail / Objectives	Lead Resource person(s)
		regions to improve P sustainability? (see suggested	
		considerations below)	
		• Will our role be unique and are we best positioned to	
		provide this service? (i.e. are other groups/platforms	
		already covering certain roles?)	
		• What is our overarching mission statement?	
12:30 - 1:30		LUNCH	
Session 2b	: The Role of th	e Phosphorus Task Team (Continued)	
		Questions for discussion:	
1.30 - 3.00	Group Discussion	• Should we function as a platform to disseminate information to stakeholders?	Chaired: Chris Cox
1.50 5.00		What do stakeholders gain from engaging with	chan ca. chi is cox
		GPNM, and the PTT in general?	
		How can we make the results of our efforts visible in	
2.00 2.20		both the short and long term?	
3:00 - 3:20		BREAK	
Session 3:	The Role of Pho	osphorus Task Team within the GPNM	
		Questions for discussion:	
		 What are the other GPNM task teams and how do they currently function? 	
3:20 - 4:50	Group Discussion	 How can the PTT input in to other task teams within GPNM? (Numerous issues concerning phosphorus (and other nutrients) are already discussed in other GPNM Task Teams) What is the potential to share events and milestones, and what do we expect from the other task teams 	Chaired: Chris Cox
		in return?	
4:50 - 5:00	Sum-up of day one	Summarizing key points of the day and plans for dinner	Arnoud Passenier

*suggested considerations for discussion in Session 2.

- Helping to create a global policy framework for P-stewardship.
- *Monitoring P-flows: from soil to dump.*
- Mapping types of P risk by geographic region.
- Raising the agenda of specific environmental issues connected to the use of phosphorus.
- Fossil and urban mining: possibilities to make both more sustainable.
- Markets & geopolitical perspectives (scarcity, disruptions of supply, product value chains).
- Product value chains: improving phosphorus use efficiency and identifying champion/influential partners in the value chain?
- Connecting global groups: GEF, The World-Bank, The International Hydrological Programme (IHP) and coordinating with global work on nitrogen (INI, TFRN, TFIAM etc.) specifically providing input to preparation of the UN Convention Task Force LTRAP and UNEP GPA "Land Based Activities".
- o Raising public awareness, coordinating global awareness in the media

Time	Session	Detail / Objectives	Lead Resource person(s)
DAY 2: 16 th	September 201	.5	
9:00 - 9:10	Recap of Day one		Arnoud Passenier
Session	4: Defini	ng Milestones, Deliverables an	d Outputs
9:10 - 10:30	Group Discussion	 Questions for discussion: What is our 'plan of action' to ensure our deliverables are SMART and help us focus to show results. What is the priority list of our ambitions on day 1? Who can help with setting up concrete actions? What milestones can we create, to accelerate actions towards those milestones (e.g. a World Nutrient Forum as counterpart of the WEF and WWF)? 	Chaired: Arnoud Passenier
10:30 - 10:50		BREAK	
Session 5:	Stakeholders, 1	Feam Members and the Planning the Way F	orward
10:50 - 11:50	Group Discussion	 Questions for discussion: Which stakeholders are essential to meet our goals and which stakeholders are we currently not engaging with? (Try to think out of the box: who would be the beneficiary of a sustainable phosphorus system in the world?) How do we proceed further? (A small Task Team and a bigger network, or a broad network?) What will be the frequency of our (physical and skype) meetings? How do we convene in the meantime and what are the roles of members and how can we create an enabling environment to support the views of all members? 	Chaired: Arnoud Passenier
11:50-12:00	Summing up	Summarizing the next steps and the way ahead	Arnoud Passenier

Annex 3 - Meeting participants

Name	Country	Organisation	E-mail
Prem BINDRABAN	US	Virtual Fertilizer Research Center (semi-autonomous unit of IFDC)	pbindraban@vfrc.org
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Annex 4 - World Resources Institute Expression of Interest



Global Partnership on Nutrient Management Phosphorus Task Team

Expression of Interest

Overview of the World Resources Institute

The World Resources Institute (WRI) is pleased to continue its work with GPNM through the Phosphorus Task Team.

WRI is the top-rated environmental think tank in the world. Its Water Program has been working on eliminating eutrophication for more than a decade. It has published on the extent of eutrophication worldwide, the drivers and sources, and policy mechanisms for addressing eutrophication. In addition, WRI has an interactive global map of over 700 eutrophic and hypoxic coastal zones. WRI is an expert on flexible, market-based solutions to cost-effectively achieve water quality goals, such as water quality trading and geographic and cost-effective targeting of conservation and restoration efforts. It is also strong in policy analysis, program evaluation, and analyses on barriers to change.

Recently, WRI was contracted by the Global Environment and Technology Foundation under the "Global Nutrient Cycles" GEF grant to develop a global database of nutrient-reducing practices and nutrient-reducing programs and policies. WRI presented these databases as well as the larger GPNM "toolbox" at the Chilika Lake workshop in India in July where it was well received. WRI is also starting development of a country-level nutrient management template for the "Global Nutrient Cycles" GEF project. We look forward to continuing these lines of work with the GPNM.

In addition to eutrophication policy expertise, WRI has unique skills in data visualization, specializing in creating accessible, user-friendly online platforms for decision makers, the private sector, and others. Through these platforms and other points of engagement, WRI brings valuable partnerships with the private sector, foreign governments, and other NGOs.

Finally, with offices in India, China, Brazil, Belgium, and Indonesia, WRI has an international presence and many local partners in developing countries.

Interest in Phosphorus Management

WRI is keen to build off of the work it's completed so far with the Global Partnership on Nutrient Management. With the existing databases and toolbox as a foundation, the Phosphorus Task Team is well poised to conduct additional research and outreach on successful, cost-effective, and replicable phosphorus management efforts.

In addition, WRI has a number of other projects outside of the GPNM that may be of interest to the Phosphorus Task Team. WRI is currently conducting a scoping exercise to formulate plans for development of a global food and water security analyzer: a web-based, publicly available interactive platform designed to inform government officials and other analysts on current and future threats to water and food security worldwide over the coming decades. Phosphorus availability and use have a significant role in global food security and could be an important component in this analyzer.

WRI is also conceptualizing a global, web-based platform to provide governments, businesses, nongovernmental organizations, scientists, and citizens with near-real time, systematic data at their fingertips on the water quality of every major lake, river, and estuary on the planet (funding dependent). By using satellite-based remote sensing to detect surface water extent, water clarity and total suspended solids, and potential algal blooms, we can derive phosphorus loads and provide a timely, large-scale global water quality monitoring system for fresh and coastal waters.

WRI looks forward to exploring these and other opportunities for collaboration via future GEF or other funding prospects and to continuing to engage with members of the GPNM and Phosphorus Task Team.

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Annex 5 Presentations

1. Dana Cordell



THE GLOBAL PHOSPHORUS CHALLENGE

The phosphorus challenge has many dimensions:

- •Environmental pollution
- Physical scarcity finite resource
- Mismanagement & inefficiency
- •Geopolitical risks
- •Fertilizer access for farmers
- •Whole food system mine to field to fork

Governance – who is responsible?

























		© Cordel 2015
MONITORI FOR FOOD	NG & TRACKING PHOSPHO SECURITY & THE ENVIRON	RUSINDICATORS MENT
GLOBAL PHOSPHORUS IN	DICATORS	 provide evidence of key phosphorus
A. Phosphate price	A.1 Phosphote commodity spot price (USS/Ionne) A.2 Normalized mediate laters frice laters	vulnerabilities or 'hotspots' in the food system
B. Market concentration & supply risk	B.1 % reserves controlled by the top 5 countries B.2 % production controlled by the top 5 producers B.3 Political/coll instability in producing countries	 stimulate effective phosphorus governance & targeted action
C. Relative physical phosphorus scarcity	C.1 Reserves by country C.2 Consumption: availability; production/reserves ratio C.3 Peak phosphonus curve	 raise awareness of this food security challenge
D. Eutrophication potential	D.1 Reported algal bicoms (frequency, severity) D.2 Media hits/year (perception of bicoms) D.3 Leakage rate from land to water (qualitative)	evaluate the effectiveness & performance of
E. Farmer phosphorus vulnerability	INDICATORS E.1 Farm incomes broits: (purchasing power parity) E.2 Properties of farm income speet on ferilizers; or % farmers not applying firstizers due to lack of affordabity/profability	growan ration an available priosphorus projects
F. National phosphorus vulnerability	L.3 Yamin Kolopis jurgiussesto (L) all Yacol) E.4 Yamigati pour (M-Brielern video L) analyticin F.1 Operatione on longin (Xiopita) F.3 Vesterione and provint (sin casts) F.3 Vesterione and the sources of P updatative assessment of rhearts (Sin operation of Singer Analytics) F.5 P took systeme Relative P angelos (Intelsen, %) P hoto consume: P angelos (Intelsen, %) F.5 P took of Intelsence P angelos (Intelsen, %) F.5 P took of Intelsence P points (Pains Castalita) essessment) F.5 P took of Intelsence (Intelsen, %)	
G. National phosphorus equity	G.1 National P consumption relative to global consumption (per capita G.2 National reserves: global reserves (per capita) G.3 Dietary P footprint nutritional security (per capita)	
H. Soil phosphorus legacy	H.1 Surplus/deficit; seil P stock H.2 Bioavailable vs. 'locked' P (estimate) H.3 Crop yield gap (associated with P fertilizers)	- " " " " " " " " " " " " " " " " " " "









- > The sustainable phosphorus challenge spans the whole food system, and ecological to geopolitical, hence diverse stakeholder set need to be engaged and collective goals
- Different regions vulnerable in different ways, hence need locally appropriate priorities & transformations
- > Innovative tools & frameworks can guide identification of local priorities and transformation pathways

Urgent need for global/national monitoring based on transparent, independent and trustworthy data (whole food system - mine to field to fork)













LACK OF EFFECTIVE GLOBAL P GOVERNANCE

- there are currently no international or national policies, guidelines or organisations responsible for ensuring long-term availability and accessibility of phosphorus for food production
- "The market will take care of it" Market system governing by default alone not sufficient to ensure equitable, timely, sustainable
- Whose responsibility is long-term phosphorus security? Governance of phosphorus is **fragmented** between many different sectors and stakeholders
- Mining & fertilizer companies? Investors? Farmers? Food retailers? Consumers? Wastewater service providers? UN?



2. Tina-Simone NESET

Phosphorus Vulnerability & Tools for Sustainable P Management

Frameworks and Tools for Sustainable P Management

- · Vulnerability Assessment
- Identifying Synergies
- Visualizing Virtual Flows Decision Support Tools
- · Interactive Data Exploration
- Visualization Supported Dialogues



Frameworks and Tools: Sustainability Attributes

- integrated (coupled human-environment systems),
- complex (multiple interacting stressors, nested scales, inherent uncertainty),
- participatory (involves the right stakeholders
- at the right time) future-oriented (present & future),
- · solutions-oriented (adaptation, resilience)
- policy-relevant

Dimensions of P Vulnerability

Phosphorus vulnerability refers to the degree to which a given food system is susceptible to harm due to the dimensions of global phosphorus scarcity



Phosphorus vulnerability is a measure of

EXPOSURE to external hazards (e.g. market price volatility of fertilizers)

SENSITIVITY (e.g. soil fertility) and

ADAPTIVE CAPACITY (e.g. financial assets)



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P Vulnerability Framework PHOSPHORUS VULNERABILITY ASSIS

Objectives:

- National assessment e.g. in what ways is Australia or India or Europe most vulnerable to P scarcity, and therefore which aspects could be prioritized for adaptive strategies to increase resilience?
- Comparative assessment e.g. which regions of the world are most vulnerable to P scarcity? (based on high-med-low rankings) and should therefore be prioritized at the global scale?



A FRAMEWORK FOR ASSESSING NATIONAL PHOSPHORUS VULNERABILITY



Numerous methods for interpreting vulnerability:

- Quantitative multi-criteria analysis (weightings)
- Quantitative indices (composite indicators)
- Qualitative participatory methods (ranking, exercises)
- Exploring adaptive strategies (e.g. participatory visualization-supported stakeholder dialogues)











Norrköping Decision Arena www.cspr.se/nda

Knowledge

Brokerage



Withers et al, 2015

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3. Arnoud PASSENIER







4. Michel PRUD'HOMME









Supply		Distribution	Uses			Stewardship
Resources	Mining Processing	Sales and distribution	Fertilizer use	Soil behavior	Recycling	Governance
Scarcity Geopolitics	Inefficiency Losses	Affordability	Losses	Soil erosion		Planetary Boundaries
Resource assessment	PPG	Distribution inefficiencies		Cadmium		
Opportunities	PPG recycling Energy & water efficiency	Fair/open trade Fair competition	Extension services 4R	Soil analysis Cd (de Cadmination)	Innovative products	Global/ Regional partnership
Sector data	PPG Study	Trade Study	Innovatio	on) (Nutrient Stewardshi	P
		GPNM P Meeting -	- Edinburg, Sep	tember 2015		

	P Rock	P Fertilizers	Industrial P
Country	35	60	20 50 (P feed)
Producers	Over 50 + China (225)	Over 300 +China (340) 125: SSP 170: NPK 100: PP	Over 100 +China (150) 20: YP 30: Industrial 60: P Feed
 Fragmented More vertical 	industry: large number al integration and dowr	r of producers and a v Istream diversification	vide range of products 1
Economies o Structural ra Competitive Wider range	of scale: large capacity o itionalisation: costs; en advantages: inputs and of P fertilizer products	developments; bigger vironmental pressure d resources, access to c competition betwee	units s; competition) markets; logistics :n complex and bulk blends
Economies o Structural ra Competitive Wider range	of scale: large capacity (itionalisation: costs; en advantages: inputs an e of P fertilizer products	developments; bigger vironmental pressure d resources, access to competition betwee	units s; competition 9 markets; logistics en complex and bulk blends Source: IFA Production and International Trade 3













GPNM P Meeting - Edinburg, September 2015

5. Tom BRUULSEMA





















6. Chris THORNTON











































