United Nations Environment Programme
برنامج الأمم المتحدة للبيئة · 联合国环境规划署
PROGRAMME DES NATIONS UNIES POUR L'ENVIRONNEMENT · PROGRAMA DE LAS NACIONES UNIDAS PARA EL MEDIO AMBIENTE
ПРОГРАММА ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ ПО ОКРУЖАЮЩЕЙ СРЕДЕ
UNEP

Second Global Conference on Land – Oceans Connection (GLOC-2)
2-4 October, 2013, Montego Bay, Jamaica

OUTPUTS FROM THE THEMATIC SESSION

Title of the Session: Sustainable nutrient management: global challenges, regional priorities and perspectives; and developing the future agenda for joint actions

The thematic discussion on Nutrients of Day 2 was divided in two sessions (detailed agenda attached) [1]. Session –I aimed to set the context and addressed the Global challenges, regional priorities and perspectives, followed by two presentations on possible solutions, one from industry and the other from academia. The session was moderated by Dr. Anjan Datta of UNEP/GPA. Session–II was devoted to "developing the future agenda for joint actions to promote sustainable management of nutrients". In this session there were four presentations followed by a Panel discussion. Prof. Mark Sutton of the Centre for Ecology and Hydrology, UK/International Nitrogen Initiative was the moderator of the second session.

KEY SPEAKERS OF THE SESSION – I AND THE TOPIC THEY ADDRESSED

1. Prof. Robert Diaz, Prof. Emeritus, Virginia Institute of Marine Science USA - *"The Coast and Oceans – home of the excess Nutrients!*
2. Prof. Mark Sutton, Centre for Ecology and Hydrology, UK, International Nitrogen Initiative – "*Nutrient Management Challenges and Policy Issues: global overview."*
3. Dr. Luiz R G Guilherme, Universidade Federal de Lavras, Brazil – "*Nutrient management challenges in Brazil and Latin America.*"
4. Dr. Cargele Masso, International Institute for Tropical Agriculture, Central Africa Hub, Kenya – "*Nutrient management challenges in Africa.*"
5. Dr. N. Raghuram, Indian Nitrogen Group/Society for Conservation of Nature, India – "*Nutrient assessment and management: From India to South Asia.*"
6. Dr. Yuelai Lu, Head of the secretariat UK-China Sustainable Agricultural Innovation Network. "*Nutrient management challenges in China."*
7. Dr. Tom J. Goreau, President, Global Coral Reef Alliance – "*Jamaica Eutrophication: Past, present and future.*"
8. Ms. Paulette Kolbusch, National Environment and Planning Agency, Jamaica – "*Nutrient Management using Wastewater and Sludge: Jamaica's approach.*"
9. Dr. Terry Roberts, President, International Plant Nutrition Institute, USA – "*Improving nutrient management in agriculture: Industry Perspective.*"
10. Prof. Tom Sims, University of Delaware, USA – "*Improving nutrient management for animal production systems.*"

MAIN DISCUSSION POINTS OF THE SESSION:

Issues and Challenges: Global Perspectives

- **Prof. Diaz of the Virginia Institute of Marine Science USA**, in his opening remarks, reminded the meeting participants of some key facts. He noted that economic growth and expanding population caused increasing input of nutrients and organic matter to coastal areas over the last 60 years, resulting

[1] For unavoidable reasons Dr. Greg Crosby of the US Department of Agriculture and Dr. Sasha Koo-Oshima of the US Environmental Protection Agency could not join the GLOC-2 and the nutrient session as envisaged and agreed upon.

in ecosystem overload. There is a strong correlation through time between (a) increased nutrient discharges and disruption of global cycles; (b) population growth and agriculture expansion; (c) increased primary production and (d) increased occurrence of hypoxia and harmful algae blooms. Prof. Diaz also emphasised that from the start of the 'Industrial Revolution' in the 1700s, it has taken >100 years to alter the global Carbon Cycle, whereas with the start of the 'Green Revolution' in 1960s it took <50 years to alter the global Nitrogen Cycle. The Haber-Bosch process is the great accelerator of the reactive nitrogen (Nr) process and interestingly enough, of the total reactive nitrogen (Nr) produced through the Haber-Bosch process, only 18 % is consumed by human population and the rest (82%) is lost to the environment.

- **Prof. Mark Sutton of the Centre for Ecology and Hydrology, UK** noted that many often argue that "we need nutrients for food security", but in reality it is not for "food security but food luxury". Quoting the European Nitrogen Assessment (2011), he argued that 85% of N harvests in EU goes to feed livestock, on average, the European eats 70% more protein than needed for a healthy diet and that Europe is a net importer of N in feed and food.

- Both speakers also argued that nutrient losses, particularly of reactive nitrogen and phosphorus, from the agricultural and sewerage systems, are among the main causes for eutrophication of our aquatic and marine ecosystems around the world. They affect water quality for human use and also affect aquatic and marine biodiversity, which in turn affect fishing, recreation, carbon sequestration and other ecosystem services. Climate change can also accentuate the effects of nutrients.

- Around the world, hypoxic zones are continuously increasing and the rise of hypoxia is correlated with high amounts of nitrogen being released into the environment and particularly in our aquatic environment. Interestingly this is not the case in areas in Asia where population is high. Initial increase in nutrient loading into the aquatic environment leads to an initial increase in fisheries production. However, as nutrient loading continues to increase, the system approaches an organic matter saturation point and at some point, organic matter is not efficiently processed through fishery species and the system gradually collapses.

- It is important to note that consequences of excess nutrients can be reduced and eliminated through management. There are approximately 60-70 sites where impacts of nutrient loadings have been minimized, particularly through implementation of management initiatives, such as municipal sewage treatment and reduction of discharges from fish/livestock production plants. Public awareness of impacts of nitrogen on ecosystems is a noted problem.

- The increased establishment of extremely large livestock farms and the related fertilizer use and by-products are rapidly becoming a severe source of nitrogen.

- Nitrogen enrichment is not yet embedded in most country's national development agendas though the consequence of too much of nutrients is multiple, with adverse impacts on Water quality; Air quality, Greenhouse gas emission; Ecosystem services and Soil health (WAGES in short).

- Under the United Nations Economic Commission for Europe (UNECE) a Task Force on Reactive Nitrogen has been established to implement activities to link effects of reactive nitrogen to policy decisions.

- The GPNM publication *Our Nutrient World* addresses many of the above noted issues and attracted media attention as the report made a link between nutrients use and food security as well food consumption issues. The report has laid the foundation for various stakeholders to discuss these critical issues further, in order to engage and motivate countries to take action towards a Nutrient Green Economy.

- The meeting recognized that currently there is no global treaty that links many benefits and threats of altered N & P cycles. Discussion should be led under UNFCCC, UN CBD and UNEP/GPA. UNEP/GPA

certainly can take the lead in the light of the IGR-3 decision and the Manila Declaration that was adopted during the IGR-3 in January 2012.

Issues and Challenges: Regional Perspectives

Latin American case was presented by Dr. Luiz R G Guilherme of Universidade Federal de Lavras, Brazil. It was stated that the region has mostly weathered soils and shows a negative "nutrient balance," meaning that more nutrients are lost through plant growth and harvest than are replaced through additions of fertilizer, manure, or legume cover crops and that leads to declining soil fertility. However, recent data shows that in the case of South America, the magnitude of the imbalance appears to be decreasing as incomes rise and farmers can afford more fertilizer. Given the soil conditions and agronomic practices in South America, much of the nutrients applied are easily leached out of soils and the main mechanism by which the P leaves the land and enters freshwater ecosystems is soil erosion. Agricultural P is the principal driver of eutrophication. P concentrated in sewage effluents and animal and industrial wastes, including P-containing detergents, could be a relatively small contributor globally, though P remains an important contributor to eutrophication locally.

To address the challenge, the agricultural practices must increase functional diversity, mimicking natural ecosystems. Techniques include no-till agriculture, cover crops, crop rotation, and enhancement of natural N fixation. Intensification must only be encouraged under sustainable practices, where agro-ecosystems and neighbouring landscapes provide key ecosystem services. It is also suggested that nutrient management should include, among others, adjusting application rates based on assessment of crop needs; minimizing losses by synchronizing the application of nutrients with plant uptake; correcting placement to make the nutrients more accessible to crop roots (micro fertilization and micro dosing) and using controlled-release forms of fertilizer that delay its availability for plant uptake and use after application. Furthermore, N&P released from untreated sewage also need urgent attention. For example, in Brazil according to a 2008 national household survey, only 28.5% municipalities had wastewater treatment systems.

Africa: Dr. Cargele Masso of the International Institute for Tropical Agriculture, Central Africa Hub, Kenya in his presentation divided the continent. Africa could be divided into 5 sub-regions in terms of its soil health. For example, in the western humid lowlands of Ivory Coast, Ghana, Nigeria and Cameroon, 58% of land area is degraded. For central humid lowlands of Angola and Democratic Republic of Congo (DRC) this stands at 40%; southern humid lowlands covering Madagascar it is 64%; east and central highlands that covers Burundi, DRC, Ethiopia, Kenya, Rwanda and Uganda this comes of 49%; southern moist savannahs covering Malawi, Mozambique, Tanzania and Zambia this stands at 43% and in the western moist savannahs covering Benin, Ghana, Nigeria and Togo this goes as high as 90%. The key factors for degradation are soil erosion, nutrient and organic matter depletion and loss of nutrient to the environment. According to some estimates, in the 38 countries of the sub-Saharan Africa, on average, nitrogen (N) loss stands at 22 kg/ha/annum, for phosphorus (P) it comes to 3 kg and for potassium (K) this comes to 15 kg/ha/annum. Cost of such losses is huge; for Zimbabwe the cost of N & P loss is USD 1.5 billion per year.

The Integrated Soil Fertility Management (ISFM) practices such as consideration of improved germplasm, and the knowledge to adapt these to local conditions, which maximize fertilizer and other agro-input, use efficiency and crop productivity, are considered the possible solutions to poor land, water and nutrient management in African agriculture. Currently, Africa uses less fertilizer than other countries in the world. However, where it is being used, there is increased acidification and loss of soil organic matter due to its inappropriate application and management.

To promote fertilizer use efficiency, it is recommended to fine-tune recommendations; strengthen the capacity of the extension systems, taking note of farmers knowledge to understand the history of their soil fertility; reduce direct and indirect taxes on fertilizer and reduction of fertilizer transport costs; and finally promote 5Rs (Right Fertilizer; Right Placement; Right Dose; Right Timing and Right Field Management) to make ISFM interventions affordable and profitable to resource-disadvantaged small-farm holders in Africa.

Asia: Two presentations were made, one covering South Asia, with a focus on India, and the other on East Asia, using China as an example.

The South Asia presentation, made by Dr. N. Raghuram of the Indian Nitrogen Group, started with a few basic statistics to elucidate the challenge this region faces. South Asia has 4.8% of the world land area, 4% of the world's coastline, 14% of the global agricultural land and with these resources it needs to feed 22% of the World's population. Currently, 94 % of the arable land has already been cultivated and this cannot expand further.

Nutrients pollution of the South Asian coastal environment is from a variety of sources, including agriculture, aquaculture, municipal and domestic sewage and industrial sources. The World's largest natural hypoxic zone develops seasonally on the Western side of India while the east coast is relatively less prone to hypoxia. Agricultural nutrient loading to coastal waters is primarily during the rainy season and floods. Among all these, sewage is the single main source of pollution of coastal waters from the land. Estuarine and coastal systems in South Asia are nitrogen limited and N loading can trigger algal blooms and eutrophication. Some of the estuaries studied, notably along the Indian east coast, are phosphorus limited and are affected by P loading. In South Asia in general, and India in particular, nutrient use efficiency in rice production system has declined substantially over the last four decades, while the fertilizer use is higher than the world average. However, in Bangladesh, Fertilizer deep placement promoted by the International Fertilizer Development Centre, has improved nutrient use efficiency substantially and that also led to increase in the income of the farm households.

The Indian Nitrogen Group and the Society for Conservation of Nature is currently undertaking a regional study, with technical support from the South Asia Co-operative Environment Program (SACEP) and the Global Partnership on Nutrient Management (GPNM), to establish the base line on nutrient use/management systems, compile the current state of knowledge and to formulate recommendations to address the identified constraints, in order to promote technological and management measures for a coordinated, sub-regional approach.

The South Asian group, in order to promote nutrient use efficiency, is working to define Strategic options (i.e., improving supply-demand synchrony; improvement in soil health and improvements in varieties); Management options (i.e., site-specific nutrient management; integrated nutrient management; improving application methods; improving the fertilizer formulations and integrated crop management); development of Tools and technologies (i.e., leaf colour chart; decision support system; remote-sensing; geographic information system and precision farming) and finally on Policy options (i.e., dissemination of available technologies; incentives for adoption of efficient technology; funding for R&D, development of professional networks, monitoring projects and infrastructure, subsidy and crop insurance).

The South Asia presentation was concluded with some key highlights of recent initiatives towards sustainable agriculture in India, which among others includes Organic farming that is catching up, not only because of value addition, but also for sustainability. Many State governments (such as Delhi and Uttarkhand) have declared their states as organic farming states. Some NGOs implemented large scale organic farming without compromising yield. e-sagu (IIIT) is implementing IT-enabled agri-advisory service in many districts for a decade and the biotechnologists are using genomics, proteomics and bioinformatics in nutrient use efficiency research.

The East Asia presentation by Dr. Yuelai Lu of UK-China Sustainable Agricultural Innovation Network (SAIN) focused on China, with the message that China's agriculture and food security is a success story. Since 1980 both grain and meat production has increased substantially. This has resulted in decrease of under-nourished population from nearly 145 million in 1995 to roughly 127 million in 2005. But this growth has come at a price. According to 2010 national pollution survey, 2.7 million MT of Nitrogen (1.7 from crop production and the rest 1.0 million MT from livestock production) and 0.3 million MT of Phosphorus (0.1 MT from crop and 0.2 MT from livestock production) are discharged in the water system.

It is stated that the nutrient management challenge in China is intimately linked to the changing dietary pattern of the Chinese society. In China, consumption of rice, wheat and other grans shows a steady decline whereas consumption of fruits, red meat and poultry, milk, fish and edible oil has marked a significant increase since 1980.

Recognizing the imminent threat of nutrient pollution, the Chinese Ministry of Agriculture has announced its resource efficiency and climate smart agriculture policy with several measures/targets to reach by 2015, compared with 2010 and they include: Ammonia nitrogen emission reduced by 10%; Fertilizer use efficiency increased by 3% and Over 50% of intensive livestock farm or livestock raising community equipped with waste treatment facilities.

China is exploring probable solutions to decrease N run-off, such as sub-surface application of N, improved timing of applications, farmer collaboration, use of N inhibitors within the soils, introduction of slow release fertilizers, and improved policy decisions related to subsidies on fertilizers.

Caribbean: Two presentations were made, one on the nature and challenges of Jamaican Eutrophication problems by Dr. Tom Goreau of Global Coral Reef Alliance, and the other on Jamaica's nutrient management, particularly use of wastewater and sludge, by Mrs. Paulette Kolbusch of the National Environment and Planning Agency of Jamaica.

Dr. Tom Goreau of the Global Coral Reef Alliance pointed out that eutrophication is a growing problem in Jamaica and the wider Caribbean. The coastal areas of the Caribbean are prone to eutrophication due to low currents, low tides and low circulation. It has been stated that excessive overgrowth of algae as a consequence of nutrients and thus creating hypoxic/dead zones is on the rise. The Kingston Harbour of Jamaica is reported to be eutrophic. There is an increase in nutrient inputs into the waters resulting from coastal developments. The eutrophic area initially starts to grow outward from the source and eventually merged with original sources until they become invisible. The immediate causality of this is coral reef, which needs clearest and purist water to grow and survive. Once the corals are destroyed the fishery gets affected, as for many of the fish species, coral serves as the habitat and spawning ground. The process can only be reversed if human nutrient inputs from land get under control.

Recognizing the importance of coral and health of the ocean for its contribution to Jamaica's economy, in the 1950s, the first diving research and tropical diving club in the world was established in Jamaica to study the health of coral and other marine resources. The data starting in the late 50s shows that by the 70s, coral reefs of the Kingston harbour, Port Royal Cays, Montego Bay and Ocho Rios and Runaway bay areas were all impacted by over-grown algae and the Ocho Rios and part of Montego Bay reefs were further impacted by dumping of dredged materials. The situation continued to deteriorate and more and more areas got impacted. Given the fact that Jamaican coastal waters have already excessive nitrogen, only a small addition of phosphorus triggers massive algae blooms. To overcome this, Jamaica urgently needs to adopt "coral reef specific water quality standards" and the thresholds could be defined based on requirements for coral growth and rate of algae growth as a function of nutrient level. In several coral rich countries, such thresholds have been worked out and we could draw lessons from their experiences. Jamaica, and for that matter, the Caribbean needs the strongest water quality standards and nutrient recycling on land to preserve the coral, its tourism and fisheries industry and thereby making its transition to sustainable development and eradication of poverty. A country such as Turks and Caicos is working on national coral reef ecosystem specific nutrient standards for nitrogen and phosphorus. There, by law, all hotels builds their secondary sewage treatment plant and recycle all their waste water on their property for irrigating the ornamental plants. The nutrient management should be the corner stone of coastal resources management. The coastal resources and/or zone management must dedicate resources to enable their people to carry out nutrient mapping. The technology is available for such exercise but we need to use them to lay the scientific foundation for coastal management.

Mrs. Paulette Kolbusch of the Jamaican National Environment and Planning Agency's presentation complemented some of the arguments advanced by Dr. Tom Goreau and she outlined Jamaican government policy with reference to nutrient management and cited the example of recovering nutrients from wastewater

through its various uses and argued that reuse of wastewater for selected land application is more beneficial than doing it through costly tertiary treatment system. It was also reported that Jamaica, in support of its nutrient management strategy, has recently banned use of phosphate in detergent through amendment of its "Commodity Standard for Phosphate in Synthetic Laundry Detergent". References were also made to several other supporting policies and legislations that complement government's effort in managing the nutrients. Under the current policy, standards for effluents discharge have been defined (e.g., maximum permissible limit is for nitrogen 10mg/L and phosphorus 4mg/L; for industrial discharge, the standards are 10mg/L for nitrate and 5mg/L for phosphates). However, for use of sewage products as soil conditioner (fertilizer) farms are obliged under law to submit nutrient management plans for approval and the plan must contain, among others, an aerial photograph/map of the area and the exact delineation of the area where this will be used and the current and/or planned crop production/crop rotation plan. The proponent/user is also expected to submit a report on all nutrients (fertilizers) used and the results achieved. The National Environment and Planning Agency is responsible for regular monitoring and reporting on the implementation of the newly introduced nutrient management policy.

A special presentation
"Ecosystem Health Report Card – a tool for monitoring nutrient loads and health of coastal ecosystems: Case study of the Chilika Lake, India".

This was a joint presentation by Dr. Ajit Pattnaik of the Chilika Development Authority, Government of Odisha, India and Prof. R. Ramesh of the National Centre for Sustainable Coastal Management, Ministry of Environment and Forest, Government of India.

Dr. Ajit Pattnaik of the Chilika Development Authority started his presentation outlining the ecological and social significance of Chilika Lake, which is a Ramsar site as well as the largest coastal lagoon in India (1000 sq. kms); is a biodiversity hotspot that houses 211 bird species; has the largest Irrawady Dolphin population; has 217 fish species, nearly one million of migratory birds during the winter period and supports livelihood base of 0.2 million fishers. However, due to natural processes and human interventions the lake ecosystem deteriorated and in 1993 the Ramsar Convention listed the Chilika Lake in the Montreux Record due to change in the ecological character. The Chilika Development Authority adopted a Restoration strategy based on the Ecosystem approach and several targeted studies were undertaken to have a better understanding of the complex ecosystem, the root causes of degradation and define technological and management interventions. In this endeavour strategic partnerships with a wide array of organizations were established and a robust monitoring protocol was put in place. In 2000 a new opening was created to link the lake with the Bay of Bengal. This technical intervention, aided by management actions, paid dividends. Among others, there was an eight fold increase in annual fish and prawn landing with consequent increase in monthly family income of fishermen; invasive species decreased and in 2002 the Lake was removed from the Montreux record. In fact, Chilika was the first site to be removed from the Montreux record due to its successful restoration.

According to Dr. Pattnaik, the Ecosystem Health Report Card that is being developed in the Chilika Lake would serve as a tool for management of Chilika Lake and its basin. He apprised that ecosystem report cards are transformative assessment and communications products that compare environmental data to scientific or management thresholds and are delivered to a wide audience on a regular basis in a transparent manner.The concept of an ecosystem health report card was discussed with various stakeholder groups of the Chilika Lake in simple terms through holding of meetings. The stakeholders welcomed the idea. Subsequently, the concept and the implementation plan were presented to the highest policy level i.e., the Chilika Governing Board which is chaired by the Chief Minister of the Odisha state of India, and received its approval.

Prof. R. Ramesh of the National Centre for Sustainable Coastal Management, the lead knowledge partner of the Chilika project gave further details on the methodology of developing the ecosystem health report card. He emphasized that the report card provides rigorous scientific assessment of key parameters based on well-defined threshold values which could also be used to develop communication products for a wide group of

audiences on a regular basis. Prof. Ramesh informed that to define ecosystem health, three set of indicators have been selected. They are Water Quality index (such as chlorophyll a, dissolved oxygen, water clarity - turbidity, total nitrogen and total phosphorus); Biodiversity index (bird species count and richness, dolphin abundance, seagrass distribution, phytoplankton and benthic diversity; and Fisheries index (total fish catch, commercial species caught -finfish and shellfish and size of species). It was reported that for each set of indices a threshold value has been defined based on (a) regulations (e.g. Indian Standards and US Environmental Protection Agency standard); (b) biological limits; (c) socio- economic requirements; (d) reference conditions, i.e. another location with similar characteristics; (e) professional judgment and (f) reference site within the system. Finally all the values will be summed up into one value to give the ecosystem a final grade in a scale of 0 to 10 and be presented with coloured maps and graphics for easy visualization.

Prof. Ramesh finally presented the results of the 2012 Chilika Ecosystem Health Report Card in terms of score, graphics and GIS maps depicting health of Chilika Lake in general and of different ecological zones of Chilika. He concluded by stating that the ecosystem health report card is designed not only to provide rigorous assessment of key indicators to provide an integrated assessment of the ecosystem's conditions, but also to communicate science and/or complex information in simple terms to facilitate engagement of various stakeholders in taking responsibilities for the management of the lake ecosystem. He also informed the meeting that the concept was presented to the key personnel associated with the World Bank aided Indian Coastal Zone Management program in the Ministry of Environment and Forest, and the Government of India and the World Bank India Country Office have agreed to replicate the ecosystem health report card in other coastal states of India. In this effort the first stakeholders' workshop has already been concluded in the coastal State of Gujarat, India.

Possible solutions – perspectives from Industry and Academia

Dr. Terry Roberts of the International Plant Nutrition Institute (IPNI) gave the industry's perspective on "improving nutrient management in agriculture". Dr. Roberts started his presentation with a definition of best management practices that are used by the industry in their work to promote and support farmers in their efforts. For industry BMP is "Research proven practices that have been tested through farmer implementation to optimize production potential, input efficiency, and environmental protection". The goal is to ensure that plant nutrients are used efficiently and effectively in ways that are beneficial to society without adversely impacting our environment. For the industry fertilizer best management practices, integrated plant nutrient management, integrated soil fertility management, code of best agricultural practices, site-specific nutrient management, etc. are components of plant nutrient management. The International Fertilizer Industry Association (IFA) in 2007 hosted an international workshop to define principles of fertilizer BMPs and a strategy for its wider adoption. The outcome of this workshop among others, was conceptualization of 4Rs (Right nutrient, Right time, Right Dose, Right timing) and that led to publication and dissemination of a document titled "Fertilizer Best Management Practices; General principles, strategy as the foundation and guiding principles for fertilizer BMPs and a concept for global framework for their adoption and voluntary initiatives vs. regulation" by IFA. He reminded the meeting that the role of fertilizer BMPs in sustainability is new and many stakeholders (e.g., farmers, crop advisers and consultants, policymakers, consumers, and the general public) have an interest in nutrient management and stakeholders have different expectations of nutrient management which revolves around the pillars of sustainability. According to him, ideally all the pillars of sustainability would be equally balanced, but in reality this does not occur and further balance between economic, social, and environmental goals for nutrient management depend on the issue, its context, and the stakeholders. In consideration of the above, the concept was further developed by IPNI scientists and they eventually developed the 4R Nutrient Stewardship programme (right fertilizer sources; right rate, right time and right place) which was also endorsed by the American Society of Agronomy in 2009. The framework is intended to aid the development and adoption of nutrient BMPs that meet the goals of sustainable development. Dr. Roberts narrated the key scientific principles of 4Rs and also gave examples of practical choices on each of the 4Rs. For example, on "right source" he made reference to commercial fertilizer, livestock manure, compost and crop residue. He also reiterated that to address sustainability one needs to pay equal attention to all 4Rs, as often rate is overemphasized and source, time and place are under-emphasised, due to investment and other required changes in farm management practices. The IPNI has developed a 4Rs use manual and that is available at www.ipni.net/4r. The manual

provides scientific principles of the 4Rs and also includes learning modules, case studies, decision support tools and use of nutrient experts for location specific recommendations on BMPs consistent with the 4R approach.

Prof. Tom Sims of the University of Delaware, USA talked about improving nutrient management for animal production systems. He noted that animal agriculture, nutrient management and global food security are closely linked. Animal production, in essence, transforms nutrients from natural resources, fertilizers and soils into "manure". Manure and agriculture were though linked throughout the history of civilization, environmental concerns about manures emerged in the 1970s, and now the worldwide issue is for water and air quality. Furthermore, global trends in systems of animal agriculture and human diets are now forcing changes and demanding innovations in manure management. According to one estimate (Bouwman et al, 2012) by 2025 there will be a "117% increase in global livestock production, which is inherently inefficient compared with crop production…and that will lead to an increase in global N and P surpluses of 23% and 54% respectively". There are now efforts to recover nutrients from manure. For example, according to a report (Kellogg et al., 2000) in the USA, only 20% of nitrogen and 37% of the phosphorus are recovered from the excreted manure. But it is possible to improve nutrient use efficiency by animal agriculture and that would ask for strategic, sustainable agri-environmental policies, tactics, and practices, comprehensive nutrient management plans – for the farmstead and cropland and alternative uses for animal by-products through technological innovations. Lessons could be learned from the Chesapeake Bay example. The 2010 Chesapeake Bay Manure Summit identified priority manure management challenges and actions and they include: achieving nutrient balance on farms, in sub-watersheds; developing markets to sustain manure management practices and systems; improving compliance with manure, erosion, and sediment control rules; improvement of on-farm infrastructure; advancement of technologies for manure application and developing and sustaining manure processing industries. The USEPA in July 2013 published a document which, based on literature reviewed, outlined contaminants in livestock and poultry manure and implications for water quality. The US Judiciary is also getting involved in addressing this. The US District Judge Sylvia Rambo on 13 September 2013 upheld the Chesapeake Bay plan and ruled that the EPA was within its authority to issue directives. She concluded by stating that balancing soil fertility in manured soils must integrate crop and animal nutrition (N: P ratios). We can improve nutrient management for global animal agriculture and that would call for agricultural and environmental policy frameworks and sustained financial support; systematic, effective education and technology transfer to our farming communities; integrated, basic and applied nutrient management research; and a strategy to "recouple" animal and crop production systems. Finally, GPNM should be a leading force in global efforts to improve nutrient use efficiency by animal agriculture.

PROPOSED SOLUTIONS TO ADDRESS THE NUTRIENT CHALLENGE

- Fertilizer Best Management Practices to be actively promoted with appropriate extension services covering issues such as soil fertility, soil conservation, etc.
- Data and information should be processed and disseminated to various stakeholders (e.g. farmers, policy makers, fertilizer sellers/distributors) in clear terms, on nutrient requirement of various crops with reference to soil condition and agronomic practice and the nutrient uptake by plants.
- Promote Integrated Soil Fertility Management (ISFM) practices and adapt research results to suit the knowledge of farmers and local agro-climatic conditions to maximize fertilizer and other agro-input use efficiency and crop productivity
- Wide application and use of 4Rs nutrient management stewardship system/principles (right time, right source, right rate and right place of nutrient application).
- Ensure adaptive management at farm levels, regional levels and policy levels to effectively implement best management practices utilizing the 4Rs process. The manual on the 4Rs scientific principles developed by International Plant Nutrition Institute (IPNI) can be used as a guide to support this process. The IPNI document is available on **WWW.IPNI.NET/4R**
- There is an urgent need to invest in R&D for development of new fertilizer products (such as fertilizer deep placement technology as promoted by the International Fertilizer Development Centre in Bangladesh and other parts) to improve crop production, ensure food security and enhancement of farm household income.

- Strengthening of private sector capacity to improve farmers' access to appropriate technologies as it is important to concurrently address supply- and demand-side issues to roll out any technological and management options to farmers
- There is a need for creating a pro-market policy environment and re-visiting current fertilizer subsidy policies that are practiced all over the world.
- There is a crucial need for government intervention to strengthen support systems to facilitate sustainability of any innovative technology and /or management system.
- The current system of concentrated livestock production warrants urgent attention. There has been a steady increase in number of livestock with trends projected to continue, with further exponential increase. Consequent of this will be an increase in manure production which has affected water and air quality severely since the 1970s due to increased N&P loadings.
- It would be important to incorporate best practices in animal husbandry, recognizing the value of manure as fertilizer, use of environmentally friendly manure spreading techniques, development of nutrient (and manure) management plans, mitigating gaseous emissions from manure through establishment of treatment ponds, buffer zones between the concentrated animal production farms and the nearby water courses, and nutrient management in livestock and urban agriculture.
- Improving nutrient use efficiency in agriculture and managing nutrients loads from other sources, such as aquaculture and animal husbandry, has many co-benefits and these needs to be highlighted in policy discussion. Currently there is no global forum/process that addresses the nutrient management from a holistic/integrated perspective. GPA, based on its mandate coming from the IGR-3, could play a catalytic role to facilitate dialogues and reaching consensus on nutrient management at the global level.

WHAT ISSUES DID PARTICIPANTS FEEL SHOULD BE INCLUDED IN THE WORK PLANS OF THE RELEVANT GLOBAL PARTNERSHIPS

- Further work to explore possible soil management options for trapping Nitrogen in the soils, given the fact that often it is not the rate of N application but the timing of the applications which lead to mass loss to the environment.
- Develop linkages with other processes and scientific work in the field of such linking N_2O emissions to Ozone depletion.
- N loading areas are not only related to N run-off. Work needs to be carried out to understand and explain why N is staying where it is (around the word) released and multi-dimensional impacts on the environment.
- Economic cost of eutrophication is not to be accounted only for fisheries but also for other sectors and services such as water quality, agriculture, biodiversity, recreational activities etc.
- Exploration of N loading in estuarine areas particularly those receiving more fresh water and the seasonal dimension of eutrophication, for example South Asia
- Oceanic circulatory patterns to N distributions and its relationship/impacts on ocean acidification.
- More research on biological recovery (not just biophysical) process, influencing factors (apart from impact of detergent as its often stated for some of the recovered sites) and the time scale of eutrophic/hypoxic zones
- More research on work in Latin America to identify the types of wastewater treatment systems currently being built and their potential effectiveness to address the problems identified.
- Research on global nitrogen cycle towards the development of an International Nitrogen Management System should be expedited so that this can contribute in the discussions of the next GPA IGR4 in 2016.
- Further research in the use of organic fertilizers which may have more N than artificial fertilizers and its potential role in addressing food security and environmental conservation.
- Development of coral reef specific water quality standards for the Caribbean and beyond.
- Nutrients need to be mapped in "real-time" to be able to effectively manage N&P introduction
- Economic valuation of coastal ecosystems to assess the impacts of nutrient loading.
- Studies to have sound scientific basis on "use of algae as indicators" of nutrient loading
- Reaching the farmers on new and innovative methods of farming and nutrients use as a part of best management practices.

- Measureable indicators are needed for best management practices and they need to be disseminated widely
- Research on manure management that is generated from current animal husbandry practices which are de-linked in often distanced places from the agricultural land which is the potential user of them.
- Research on extraction of heavy metals (such as Cu and Zn) from manure is needed

LIST ANY ACTIVITIES THAT THE PARTICIPANTS AGREED TO UNDERTAKE THEMSELVES/JOINTLY IN THE PERIOD 2013-2016 TO FACILITATE IMPLEMENTATION OF THE GPA AND WHAT ROLE THEY FORESEE FOR THE GPA COORDINATION OFFICE IN THAT PROCESS.

- Publishing a book exploring the methodologies of trapping nitrogen in soils (Dr. Tom Goreau of the Global Coral Reef Alliances)
- Developing a comprehensive data base and mapping of current and potential hypoxic/eutrophic zones of South Asia (Prof. Ramesh of the National Centre for Sustainable Coastal Management India with support from Prof. Diaz and WRI)
- Support to African governments and other key stakeholders to develop policies on sustainable land management and that could facilitate integrated soil fertility management to ensure crop production, reduce nutrient mining and also reduce nutrients run-off
- Advocacy and outreach for drawing attention to the need and importance of wastewater treatment which have a significant bearing on the quality of coastal waters and human wellbeing
- Continue collaboration between SAIN and GPNM to contribute to and monitor implementation of the Chinese 5 year agricultural plan that is aimed to increase grain yield, introduction of good farming practices, use of ferti-irrigation and efficient nutrient use.

Session – II: Developing the future agenda for joint actions to promote sustainable management of nutrients.

The session was moderated by Prof. Mark Sutton of the Centre for Ecology and Hydrology, UK, Chair of the International Nitrogen Initiative and Member GPNM Steering Committee.

The session was organized in two parts. It started with four presentations followed by a panel discussion.
The four presentations were made by

1. Dr. Anjan Datta, GPA and GPNM Secretariat – "Developing a collaborative agenda for sustainable nutrient management."
2. Dr. David Coates, Convention of Biological Diversity Secretariat, Montreal, Canada – "Opportunities for nutrient (nitrogen) management within the CBD."
3. Dr. Gérard Bonnis, Organization for Economic Cooperation and Development, Paris – "Addressing the human impacts on the nitrogen and phosphorus cycles – an OECD perspective."
4. Prof. Jan Willem Erisman, Louis Bolk Institute, The Netherlands, "Addressing the nutrient challenge – where we are and what needs to be revisited and/or strengthened further."

MAIN DISCUSSION POINTS OF THE SESSION

Dr. Anjan Datta of GPA & GPNM Secretariat, in his presentation, reiterated that nutrients such as nitrogen and phosphorus are key for maintenance of soil health to grow crops and thus ensuring world food security. In today's world, food security of two-thirds of the world's population depends on availability and use of fertilizers. However, often inappropriate use of nutrients leads to a number of unintended consequences, impacting human wellbeing and ecosystems. Given the present mode of production and its use, nutrient contamination has become a systemic problem. The global community, while recognising the importance of nutrients, also called for actions to promote sustainable production and use of nutrients so as to reduce the unintended impacts of nutrients in the environment. The global community through the Washington Declaration of 1995 identified nutrients as one of the source categories of the Global Programme of Action (GPA). This call was reiterated by the governments during the intergovernmental review meeting of the GPA in 2001, 2006 and 2012

and the World Summit on Sustainable Development in 2002 held in Johannesburg, South Africa. The CBD 2011-2020 Strategic Plan for Biodiversity and the Aichi Targets outlined in "Living in Harmony with Nature", the Rio+20 Outcome document "The Future We Want", and the United Nations Secretary General's 2012 Oceans Compact "Healthy Oceans for Prosperity" all made explicit references to the need for and urgency of managing our nutrient world. In recognition of the above, UNEP in its 2014-2015 program of work committed "to catalyse actions through the multi-stakeholder Global Partnership on Nutrient Management to reduce and, where possible, eliminate threats to aquatic environments from land-derived nutrients". Dr. Datta concluded his presentation by stating that effective nutrient reduction strategies would call for new approaches and outreach to society as well as a broad partnership of governments, industry, the science community, international agencies, regional intergovernmental bodies and NGOs to address the nutrient challenge and the GPNM and UNEP are fully committed to work with all stakeholders to address the unintended impacts of current production and use of nutrients.

Dr. David Coates of the Secretariat of the Convention on Biological Diversity (CBD) outlined the CBD's conservation agenda and explained the link between biodiversity conservation with poverty eradication and maintaining value of ecosystem services. He stated that some of the CBD 2011-2020 strategic plan for biodiversity and the Aichi targets are relevant to GPNM. The Target 8 and the relevant indicators is addressing pollution and nutrients, while Target 3, calls for addressing incentives, including elimination, phase out or reforming of subsidies that are harmful to biodiversity and Target 7 calls for managing agriculture, aquaculture and forestry sustainably for ensuring conservation of biodiversity. He also emphasised that the issues of soil management and nutrient recycling in soils are of crucial importance for managing sustainability and ensuring food security. He further reminded that from a conservation perspective, the control of nutrients will not reduce food security, but instead provide capacity for synergies in land-water-fertilizer use to promote food security.

Dr. Gérard Bonnis of the Organization for Economic Cooperation and Development (OECD), Paris talked about 'human impacts of the nitrogen and phosphorus cycles' from a water security perspective. He noted that water security is about establishing an acceptable level of water addressing four risks: (i) risk of shortage ; (ii) risk of inadequate quality ; (iii) risk of excess and (iv) risk to freshwater systems (resilience). Using the data from the OECD Environmental Outlook of 2008 and European Nitrogen Assessment of 2011, he projected the cascading effects of nitrogen on coastal waters by 2030. He also demonstarted the loads on nitrogen and phosphorus in to the water of various seas (i.e., Artic ocean, Atlantic ocean, Indian ocean ; Mediterranean and Black sea and Pacific ocean) over time, from 1950, 1970, 2000 and with a projection of 2030 and 2050. He argued that for managing nutrients it is important to set the acceptable levels of risk that stems from current scale and mode of uses and the consequences and cost of amelioration. According to him, a risk-based approach allows the assessment of policy priorities related to biodiversity, energy security, climate change, food security, economic benefits or water security. The aim of policy should not be to reduce nitrogen emission everywhere and at any cost, but the aim should be to improve water quality and identify the areas that are at risk of being affected by nutrient loading. Furthermore, policies related to water security require the use of economic instruments such as tax incentives, trading schemes, payments for ecosystem services, taxation on externalities, emission taxes, carbon sequestration, carbon cap and trade, climate mitigation etc. Other interventions would include agricultural policy reform, farmers' education and participatory approaches to nutrient management.

Prof. Jan Willem Erisman of the Louis Bolk Institute, The Netherlands spoke on 'addressing the nutrient challenge - where we are and what needs to be revised and/or strengthened further'. He stated that in the coming years nutrient inputs into the environment will increase, and given the uneven distribution of nutrients around the globe, in some parts, shortages of nutrient will hamper growth and development whereas in surplus regions pollution and ecosystem degradation will continue to be more intense if measures are not put in place. The greatest challenge, of course, is 'how to realize optimum agricultural productivity, high efficiency of resource use (i.e. nutrient use efficiency), improve and sustain soil fertility, better environment quality and finally profitability for all. Best management practices advocated by various stakeholders are aimed at improving productivity and profitability, and preserving the environment, but the progress is rather slow. Attention to policy reform and/or policy development is crucial in order to expedite the process. Consumer's perception and behavior can also trigger changes. Information and best practice opportunities or management options that are

cost-effective need further attention for wider dissemination and they could also be used to develop toolboxes to offer the decision-makers informed and interactive access to cost effective, replicable tools and approaches to support policy development and implementation of nutrient management strategies. Citing the example of the Netherlands, he reminded the meeting that it is possible to increase agricultural production while decreasing nutrient inputs and losses. He concluded his presentation by putting a few questions for deliberation by the panel in the subsequent session, and they were: (i) what new knowledge, technologies and policy options are needed to ensure that future nutrient use is sustainable, improves food security and environmental quality and provides benefits to the poor; (ii) what target should we set for our action, what indicators we should use to assess progress and what actions we should pursue through GPNM to initiate change and/or improve nutrient use efficiency; (iii) what indicators we should use as nutrient performance and nutrient use efficiency indicators and (iv) what further actions we should pursue to strengthen the nutrient partnership.

WHAT ISSUES DID PARTICIPANTS FEEL SHOULD BE INCLUDED IN THE WORK PLANS OF THE RELEVANT GLOBAL PARTNERSHIPS

CBD has not really focused on agricultural impacts on biodiversity but recognizes that it is important to get the inter-related issues in to the agenda

LIST ANY ACTIVITIES THAT THE PARTICIPANTS AGREED TO UNDERTAKE THEMSELVES/JOINTLY IN THE PERIOD 2013-2016 TO FACILITATE IMPLEMENTATION OF THE GPA AND WHAT ROLE THEY FORESEE FOR THE GPA COORDINATION OFFICE IN THAT PROCESS.

- The GPNM will endeavor to get the issues of nutrient management on the agenda at global environmental conferences
- CBD to develop collaboration with GPNM in its effort to realize the Aichi Target 8 and outline activities for global management of nutrients.

Panel discussion: Framing the next steps "Integrated approach to nutrient management".

Panellists included representatives from OECD (Dr. Gérard Bonnis), Government of the Netherlands (Ms. Hermien Busschbach), CBD (Dr. David Coates), India (Dr. Ajit Pattnaik) and IPNI (Dr. Terry Roberts).

The members addressed the following key success questions:

- What new knowledge and technologies exist and can be introduced to manage nutrient loadings?
- What new and relevant nutrient management policies should be developed to promote change?
- What are the best indicators to be developed to monitor the effectiveness of nutrient management plans and programs?
- How can the stakeholders be reached and educated to change practices?
- What key actions (policy analysis, policy reform, defining nutrient performance indicator and nutrient use efficiency, strengthening of partnership, supporting on the ground interventions) are needed?
- Who will be the main actors?

WHAT ISSUES/CHALLENGES LIMIT THE IMPLEMENTATION OF THE GLOBAL PARTNERSHIP ON NUTRIENTS

- Social political and economic constraints to upgrading the solutions worldwide needs concerted attention
- On-farm nutrient management, technology transfer and incentives to farmers is needed to promote reduction in nutrient loadings
- Integrated approach to economic valuation and benefits should be used as a push to implementing nutrient management initiatives
- More education on nutrient management stewardship and the benefits this brings to individual farmers and the society as whole
- Nutrient use efficiency indicators and indicators on emission of nutrients are needed urgently
- Crop production should be linked to animal production to capitalize on manure use

- Draw lessons for the Netherlands and other countries where agricultural productivity has not been compromised while improving nutrient use efficiency and environmental sustainability
- Partner with Phosphate Value Chain i.e. return of phosphates to the cycle to facilitate change and draw lessons
- Work with government and other stakeholders for the development of regulations and enforcement to compliance in a bid to reduce nutrient loadings
- Promote subsidizing system approach as opposed to giving subsidies to individuals or a product
- Risks associated with nutrient management should be identified, and *Concern Assessment* of the risks by the population associated with nutrient loadings (such as diets of people)
- Establishment of the acceptable level for nutrient loading (the tipping point)

LIST ANY PRIORITIES, ACTIVITIES AND ACTIONS THAT NEED TO BE UNDERTAKEN FOR THE PERIOD 2013-2016 TO FACILITATE IMPLEMENTATION OF THE GPA AND WHAT ROLE THEY FORESEE FOR THE GPA COORDINATION OFFICE IN THAT PROCESS.

- Quantify the co-benefit (environment and human health benefit) of sustainable nutrient management
- Work being done in Brazil on nutrient management should be explored and replicated
- Promotion of organic farming
- Timescales for recovery of ecosystems once nutrient loadings are minimized need to be explored
- Use global platform events (such as World Cup) and social media to promote information on nutrients (its relationship with human wellbeing and the environment). N-footprint could be used as a tool to promote this. In addition, "Champions" should be identified, or even naming signature days/years to promote GPNM activities
- Countries with severe nutrient loading problems should undergo research to understand the types of loadings and the sources
- Explore N-Footprint and use events like UN Environment Assembly (UNEA) to promote further discussion on this. UNEA Ministerial dinner could be used as an opportunity to expose the link between our consumption patterns/food choices and the nutrient challenge.
- Focus on capacity building of farmers in overcoming the barriers they are faced with in terms of nutrient management and growing of crops
- Close cycle of nutrients (keeping nutrients within the loop)
- Nutrient stewardship needs to be science based
- Mapping of risks as it relates to the current nutrient use patterns
- Restore ecological foundation of farming systems to promote water and food security
- Nutrients (mis)use and its relation to trade needs to be studied
- Raise profile of science communication

GPNM Session Agenda

Subject	**Sustainable nutrient management: global challenges, regional priorities and perspectives; and developing the future agenda for joint actions**	**Run Dates**	**3 October 2013**
Background	Nutrients - nitrogen and phosphorous are key to growing crops and thus to the world's food security. However, in some parts of the world farmers do not have access to enough nutrients to grow crops and feed the growing populations, while in many other parts of the world there is an 'excess' of them in the environment as a result of industrial and agricultural activity and this has profound impacts, from pollution of water supplies, creation of dead zones to the undermining of important ecosystems and the services and livelihoods they support. The result is a seeming divide between societal needs for food and energy and a complex web of adverse environmental impacts, which undermine the natural resource base and the services and livelihoods it provides. This divide – 'the nutrient challenge'- is set to intensify, to the cost of countries, as population, urbanization and food and energy demands increase. If the nutrient challenge is to be met, it will be important to improve nutrient use efficiency and availability of nutrients in the areas of overall shortage (e.g., in Africa) in order to meet the global target of food security. This session will examine the nature of the global challenge and how to meet the challenge of greater nutrient use efficiency in the food production systems in various regions of the world, as both too little or too much of nutrients have impacts on food security, human wellbeing and the environment.		
Chair/Facilitator /Moderator	Dr. Greg Crosby and Prof. Mark Sutton	**Time: Start**	08:30
Location		**Time: End**	18:00
Attendees:	Representatives of governments, industry, science community, NGOs and UN agencies.		
Objective	To facilitate consensus building among the various stakeholders on the nature and scale of the nutrient management challenges from a global and regional perspective.		
Key questions	To seek to distil the nature of the nutrient challenge and answering clearly why should anyone care, how has the problem got worse, what is already being done, and what still needs to be done.		
Expected recommendations from the discussion	It is argued that if the world is going to learn to manage its nutrients better, then the world's citizens need to be motivated to make it happen. This session aims among others to frame the key messages for steering actions by various stakeholders to promote sustainable nutrient management in the context of food security and environmental sustainability.		
Organization partners	GPNM Partners: Governments of the USA, Netherlands and India Agencies: INI, IFDC, IPNI, IFA, FAO, CDA, ING, NCSCM and others		
Structure for discussion	Presentations and panel discussions		

Program Outline		
Duration	**Topic**	**Lead/Chair/Facilitator/Speaker**
Session I: Global challenges, regional priorities and perspectives - Chair Dr. Greg Crosby		
08:30- 08:45	Introduction to the session	Dr. Greg Crosby US Department of Agriculture
8:45 – 09:15	Nutrient Management Challenges and Policy Issues: global overview	Prof. Mark Sutton Centre for Ecology and Hydrology, UK International Nitrogen Initiative
09:15 - 09:45	The Coast and Oceans – home of the excess Nutrients!	Prof. Robert Diaz Prof. Emeritus, Virginia Institute of Marine Science USA
09:45– 10:00	Questions, Answers and Discussion	
10:00 - 12:00	Regional Perspectives (15 minutes presentation followed by Q&A)	
10:00– 10:20	Nutrient management challenges in Latin America	Dr. Luiz R G Guilherme Universidade Federal de Lavras, Brazil.
10:20- 10:40	Nutrient management challenges in Africa	Dr. Cargele Masso International Institute for Tropical Agriculture, Central Africa Hub, Kenya
10:40 –11:00	*Coffee*	
11:00– 11:20	Nutrient management challenges in Asia	Dr. N. Raghuram Indian Nitrogen Group/Society for Conservation of Nature, India
11:20-11:40	Nutrient management challenges in the Caribbean	Dr. Thomas J. Goreau President, Global Coral Reef Alliance
	The next two presentations are on solutions	
11:40-12:10	Improving nutrient management in agriculture. Industry Perspective	Dr. Terry Roberts International Plant Nutrition Institute, USA
12:10– 12:40	Improving nutrient management in livestock production systems	Prof. Tom Sims University of Delaware, USA
12:40 -13:00	**Questions, Answers, Discussion and Synthesis**	
13:00– 14:00 13:00– 13:30	*Lunch Break* ***Special Event: Ecosystem Health Report Card of Chilika Lake India***	
14:00– 18:00	**Session 2: Developing the future agenda for joint actions to promote sustainable management of nutrients.** Moderator Prof. Mark Sutton Centre for Ecology and Hydrology UK/International Nitrogen Initiative	
14:00 –14:20	Developing a collaborative agenda for sustainable nutrient management	Dr. Anjan Datta GPNM Secretariat
14:20– 14:40	Opportunities for nutrient (nitrogen) management within the CBD	Dr. David Coates Convention on Biological Diversity Secretariat Montreal, Canada
14:40-15:00	Addressing the human impacts on the nitrogen and phosphorus cycles – an OECD perspective.	Dr. Gérard Bonnis Organization for Economic Cooperation and Development, Paris
15:00-15:30	Addressing the nutrient challenge – where we are and what needs to be revisited and/or strengthened further.	Prof. Jan Willem Erisman Louis Bolk Institute, The Netherlands
15:30-16:00	Coffee	
16:00– 17:45	Panel discussion: Framing the next steps "Integrated approach to nutrient management": key actions (policy analysis, policy reform, defining nutrient performance indicator and nutrient use efficiency, strengthening of partnership, supporting on the ground interventions) and actors. Each Panel members will be requested to share their thoughts on "Integrated approach to nutrient management" for 3 minutes, and give 5 key action points: "what needs to be done, what are the crucial levers to facilitate actions, what experiences can you share to demonstrate that they worked, and if not what did not work and why.	Panellists to include Representatives from OECD (Dr. Gérard Bonnis), Governments of the US (Dr. Sasha Koo-Oshima and Dr. Greg Crosby), Netherlands (Ms. Hermien Busschbach), CBD (Dr. David Coates), India (Dr. Ajit Pattnaik) IPNI (Dr. Terry Roberts)

17:45-18:00	Synthesis and key conclusions	Prof. Mark Sutton
Short video show **Nutrient Runoff - Two Minutes on Oceans with Jim Toomey**		