



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



Lessons Learned - Core Project Components

GEF International Waters Experience Notes

Prepared by: World Resources Institute

Component A: Doc: A3-3

Partners:



September 2018

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)



International Waters: Learning Exchange and
Resource Network (IW:LEARN)

GEF IW Experience Notes Format

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Abstract: The Global Nutrient Cycle (GNC) project was designed 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. This experience note focuses on the activity of developing a Global Nutrient Management Toolbox. Recognizing a lack of strategic advocacy and cooperation at the global scale around this nutrient challenge, the Global Partnership on Nutrient Management developed the Global Nutrient Management Toolbox to help fill this gap. It contains policy and practice options and guidance for reducing nutrients and resources to assess nutrient loading rates from catchments. Two training workshops provided insights into what impact the Toolbox could have on the ground and in policy settings, such as in meeting the SDGs. The Toolbox was a keystone of the greater GNC project, as it pulled together the learnings and expertise of the diverse partnership, including those working across other components and activities. Its development demonstrates the strength of leveraging partners to achieve a common goal.

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With input from Chuck Chaitovitz, Global Environment and Technology Foundation; Albert Bleeker, Netherlands Environmental Assessment Agency; Ajit Pattnaik, formerly Chilika Development Authority; Sasha KooOshima, UN Food and Agriculture Organization (formerly U.S. Environmental Protection Agency)
UN Environment and the Global Partnership on Nutrient Management

1. TITLE

Development of a Global Nutrient Management Toolbox to Improve Coastal Water Quality Management

2. PROJECT TITLE

“Global Foundations for reducing nutrient enrichment and oxygen depletion from land-based pollution in support of global nutrient cycle”

GEFSEC Project ID: 4212

GEF Agency Project ID: 576

3. PROJECT DESCRIPTION

The overarching objective of this four-year project, known as the “Global Nutrient Cycles (GNC)” project was to provide the foundations (including partnerships, information, tools and policy mechanisms) for governments and other stakeholders to initiate comprehensive, effective and sustained programmes addressing nutrient over-enrichment and oxygen depletion from land-based pollution of coastal waters in Large Marine Ecosystems.

The project was designed around four components:

- Component A: Global Partnership on Nutrient Management addresses causes and impacts of coastal nutrient over-enrichment and hypoxia
- Component B: Quantitative analysis of relationship between nutrient sources and impacts to guide decision making on policy and technological options
- Component C: Establishment of scientific, technological, and policy options to improve coastal water quality policies in LMEs and national strategy development
- Component D: Development of nutrient reduction strategies through application of quantitative source-impact modeling and best practices in Manila Bay watershed

This experience note will focus on the activity of developing a Global Nutrient Management Toolbox (“Toolbox”), the main output of Component C. The Toolbox was designed to help inform resource managers and policy makers on the development of national nutrient reduction strategies. It contains policy and practice options and guidance for reducing nutrients and resources to assess nutrient loading rates from catchments, including:

- A global database of best practices for reducing nutrients from various sectors
- A global database of policies for addressing nutrients
- A set of case studies on selected technology and policy options
- A synthesis report illustrating the application of eight key best practices in nutrient hot spot regions
- A Toolbox Calculator for assessing nutrient loads and exploring future scenarios for reduction opportunities by basin

The development of the Toolbox involved the expertise and assistance of a variety of partners including UN Environment, the Global Environment and Technology Foundation, the Energy Centre of the Netherlands, and the World Resources Institute. These partners worked collaboratively toward a shared objective of developing a resource that would help decision makers develop national and large marine ecosystem scale strategies for improving coastal water quality.

4. DESCRIPTION OF ISSUE(S), CHALLENGE(S) AND EXPERIENCE

The Issues

Nutrients, nitrogen and phosphorus, are critical for growing crops and feeding the world. However, too many nutrients can be harmful to the environment. Human activities produce around 120 million tonnes of reactive nitrogen each year, two thirds of which goes unused and pollutes the world's water quality, air quality, greenhouse gas balance, ecosystems, and soil quality. Anthropogenic mined phosphorus is also added to the natural cycles. Although phosphorus is a finite resource, nearly half of what is produced goes unutilized and enters waterbodies as a pollutant.

Nitrogen and phosphorus fertilizer use has increased substantially since the 1960s is projected to increase by 40-50% through 2050 in order to feed the planet's growing population. We face a nutrient challenge to produce more food and energy while at the same time decreasing our pollution and lifting more than 500 million smallholder farmers in developing countries out of poverty. How we handle this challenge has significant implications for our ability to meet the Sustainable Development Goals, produce enough food while protecting our environment and health, and reducing poverty.

Addressing the Issues

This project was designed to address this nutrient challenge—providing food and energy for a growing population while protecting our natural resources. Recognizing a lack of strategic advocacy and cooperation at the global scale around this nutrient challenge, the Global Partnership on Nutrient Management developed the Global Nutrient Management Toolbox to help fill this gap. The Toolbox was designed to be a resource base for the community of practice and thereby help to increase attention to and drive action around sustainably managing nutrients across various sectors—agriculture, urban, wastewater, and energy.

The Toolbox provides insights through basin-scale models into nitrogen sources and loads to surface waters and coastal zones. It also contains databases, case studies, and syntheses on promising practices, technologies, and policies in use around the globe which can be considered to reduce nutrient loads. The Toolbox also includes a future scenario generator to examine the effects of these practices and policies on nutrient loadings.

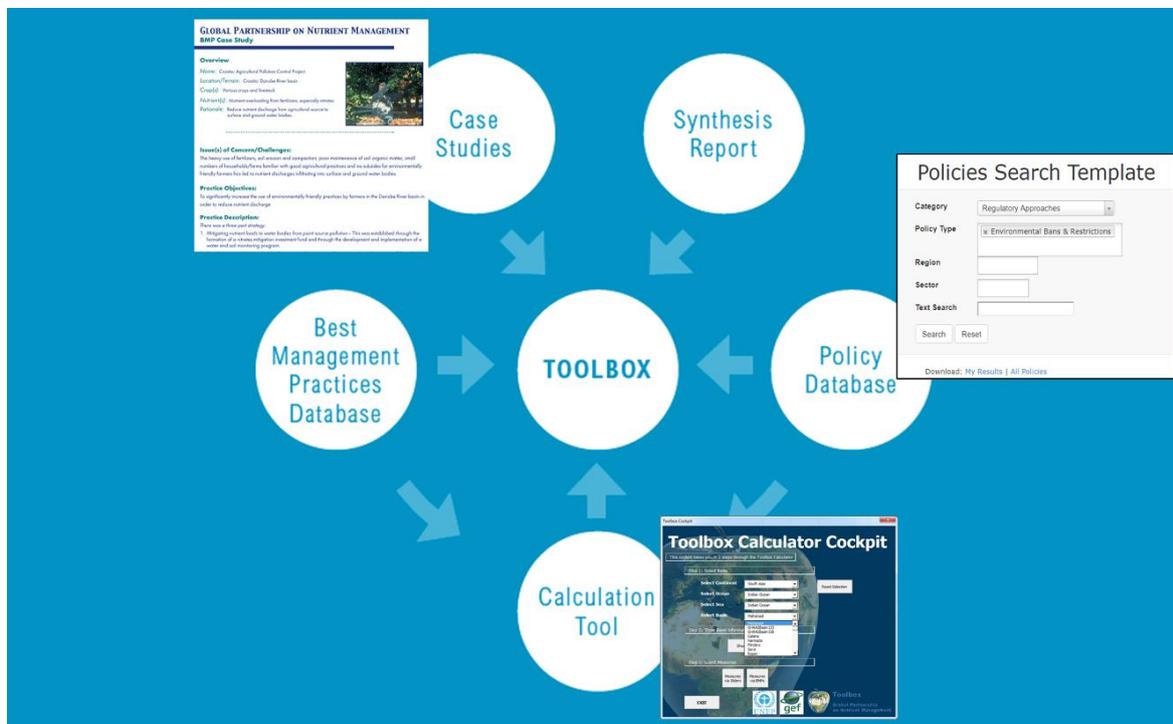


Figure 1. Contents of the Global Nutrient Management Toolbox

There is a direct link in the Toolbox to SDG 14.1 which aims to reduce marine pollution from land-based activities by 2025. The Toolbox will provide a basin-by-basin score using the Index of Coastal Eutrophication Potential (ICEP), an indicator for monitoring this SDG goal. ICEP uses modeled

nutrient load information to estimate the potential for eutrophic conditions to develop in the coastal zone. Decision makers and practitioners alike who are considering nutrient management interventions can use the Toolbox to inform their decisions and maximize environmental, economic, and social benefits.

During and after the Toolbox's development, the partnership carried out training activities with targeted users including government officials, agricultural extension agents, farmers, and GEF project managers and partners. One workshop was held in Chilika Lake, India—a key engagement watershed under the GNC project, and another was held in Negombo, Sri Lanka as part of the GEF International Waters Conference. Participants were asked to provide feedback to the project team on the utility of the Toolbox from their perspectives as agricultural extension agents, practitioners, and policy makers.

5. RESULTS AND LEARNING FROM EXPERIENCE

The Toolbox marks an important first step in bringing together informational materials and tools for exploring practices and policies for reducing nutrients. The Toolbox was a keystone of the greater GNC project, as it pulled together the learnings and expertise of the diverse partnership, including those working across other components and activities. Its development demonstrates the strength of leveraging partners to achieve a common goal.

The two training workshops provided insights into what impact the Toolbox could have on the ground and in policy settings. Training participants were keen to learn more about how to better manage nutrients and to assess nutrient loadings, and how to reduce them, in their respective basins. Particularly in Chilika Lake, the agricultural community was interested in being better stewards of their land, particularly rice fields, but their formal training in nutrient management was limited. The experiences from the workshops confirmed the need for such a resource.



Figure 2. Training on the Toolbox with stakeholders in Chilika Lake, India

Over the course of the Toolbox's development and promotion, the project team learned some important lessons about how it could be more useful and impactful:

- *Formal ownership:* Given the nature of the GEF project and partnership, the Toolbox was the product of many efforts and individuals. For example, with many partners at the table comes many perspectives, and this led to a lack of clarity about what the end product should look like and what the necessary inputs to that product should be. The Toolbox's strategic plan could have been improved with greater and more consistent ownership throughout the project lifespan.

- *More thoughtful outreach at the regional and country-scale:* Outreach under the GEF project engaged a wide range of public and private sector stakeholders and is and will continue to be critical to the Toolbox's success. More training events like the ones held in Chilika Lake, India and Negombo, Sri Lanka should be planned to secure local buy in, solicit feedback, and educate users on its utility. Training events should be coordinated in collaboration with local partners and be translated into the local language.
- *Sustainability plan:* Without continued funding to support it, there is a risk of the Toolbox becoming a static resource upon completion of the GNC project. Putting a sustainability plan in place can ensure that the Toolbox will continue to evolve, perhaps as a gateway for capacity building and trainings (e.g., Massive Open Online Courses) to continue to drive users to the site, drum up interest, and secure funding.
- *Consider scale of application:* The global scale of the Toolbox was not only very ambitious, but it comes with implications for the usefulness of the information. Regional and/or sector-specific versions could help to customize the information and obtain local buy in.
- *More investment is needed for the science to catch up to the policy:* The Toolbox was initially designed to provide a database of best practices and policies for managing nutrients. However, the project team quickly learned that data on the effectiveness of best practices at reducing nutrients is limited, and quantified outcomes from the implementation of policies and programs is also limited. Without effectiveness data to provide evidence for the promise of these approaches at improving water quality, the Toolbox's functions are hampered.
- *Integrated, cross-sector approaches are critical:* While the Toolbox focuses mainly on non-point sources of nutrient pollution, untreated wastewater is a leading source of nutrients in many basins, particularly in the developing world. Therefore, the Toolbox Calculator suggests that even with maximum implementation of best management practices on agricultural land, water quality may continue to suffer in some basins. Nutrient management plans must consider comprehensive strategies for addressing both point and non-point sources. For example, strategies could include some combination of wastewater treatment regulations, new technology development, land-based best practices for farms and urban areas, and innovative market-based or financial instruments to accelerate and incentivize action.

6. REPLICATION

Based on the project team's experience developing and promoting the Toolbox, others should consider the following challenges and enabling conditions if they are pursuing developing a comparable decision-support resource:

- *Globally comparable data on practice effectiveness estimates, policy outcomes, and costs of interventions are limited.* Allocate resources to expand research into other languages, conduct peer reviewed journal literature reviews, and convene panels of experts.
- *Outreach will be limited to people who can understand the language of the product.* The Toolbox's contents are written entirely in English, yet many of the users we are trying to reach may not speak or read English fluently. Resources should be spent on translation to key languages in order to broaden the reach of the product.
- *Global products have limited utility at local scales.* Pilot test regional versions of the product in target watersheds or countries. Find a local champion. For example, the India National Centre for Sustainable Coastal Management is hosting the GPNM website and is a key supporter of the Toolbox.
- *Cooperation from experts and local stakeholders is critical.* A global decision-support resource must be informed by subject matter experts from across the globe and by local stakeholders who are targeted as beneficiaries of the product.
- *Outreach plans should be developed from the outset.* Without sufficient outreach, even the best designed products will fall short of delivering outcomes. Decision makers must be made aware of the product, participate in its development as a stakeholder, and be trained on how to use it.

There will be an immediate opportunity to learn from the lessons from this project as many of the same partners carry out the activities of the "Towards an International Nitrogen Management System" GEF project. We hope that through this project and other opportunities we can continue to push forward useful content and outreach on nutrient management globally.

7. SIGNIFICANCE

Nutrient pollution does not receive the attention that it deserves. While climate change, deforestation, loss of biodiversity, and many other issues at the forefront of the international stage are also important, attention to nutrients has been limited. This Toolbox provides a first attempt at providing a “one-stop shop” for nutrient loading and water quality data and for nutrient management information and resources.

Perhaps most importantly, it can be a powerful tool for meeting and assessing progress toward SDG 14.1. We look forward to continuing to enhance and promote the Toolbox, particularly in the SDG community. With countries needing to meet SDGs around food, water, and nutrients, these efforts could catalyze future development of the Toolbox. And in turn, the Toolbox can continue to serve as a valuable resource for decisions makers attempting to address the nutrient challenge.

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- Global Environment and Technology Foundation: Chuck Chaitovitz, chuck.chaitovitz@getf.org
- Netherlands Environmental Assessment Agency: Albert Bleeker, albert.bleeker@pbl.nl
- Chilika Development Authority: Ajit Pattnaik, ajitpattnaik13@gmail.com (retired)
- UN Food and Agriculture Organization: Sasha KooOshima (formerly U.S. Environmental Protection Agency), sasha.koo@fao.org

9. KEYWORDS

- Nutrients
- nutrient management
- decision-support tool
- best practices

Project partners:





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UN Environment and the Global Partnership on Nutrient Management

1. TITLE

Development of Ecosystem Health Report Cards for Chilika Lake, India and Laguna de Bay, the Philippines

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This experience note will focus on the activity of developing ecosystem health report cards in Chilika Lake, India and Laguna de Bay, Philippines.

Ecosystem health cards are science communication tools that can be used to track and report on the health of water bodies at local and regional scales. Chilika Lake and Laguna de Bay had a wealth of water quality monitoring data, but scientists were keen to leverage that data to support policy makers in their decision-making. The report cards allow for scientists, policy makers, and the general public to:

- Track and report nutrient over-enrichment/health of lakes, rivers, and coastal ecosystems
- Enhance understanding of the challenges and management of the ecosystem
- Communicate easy to interpret indicators for nutrient loads and environmental status, stimulating the local community to protect their lake/Bay/river
- Feed into nutrient reduction strategies and implementation plans and inspire policy makers to provide policy support and funding for restoration activities
- Enable community members and leaders to compare their grades with their neighbors in a healthy competition for better environmental outcomes

4. DESCRIPTION OF ISSUE(S), CHALLENGE(S) AND EXPERIENCE

The Issues

Nutrients, nitrogen and phosphorus, are critical for growing crops and feeding the world. However, too many nutrients can be harmful to the environment. Human activities produce around 120 million tonnes of reactive nitrogen each year, two thirds of which goes unused and pollutes the world’s water quality, air quality, greenhouse gas balance, ecosystems, and soil quality. Anthropogenic mined phosphorus is also added to the natural cycles. Although phosphorus is a finite resource, nearly half of what is produced goes unutilized and enters waterbodies as a pollutant.

Nitrogen and phosphorus fertilizer use has increased substantially since the 1960s and is projected to increase by 40-50% through 2050 in order to feed the planet's growing population. We face a nutrient challenge to produce more food and energy while at the same time decreasing our pollution and lifting more than 500 million smallholder farmers in developing countries out of poverty. How we handle this challenge has significant implications for our ability to meet the Sustainable Development Goals, produce enough food while protecting our environment and health, and reduce poverty.

These challenges were explored locally by the GNC project in two coastal ecosystems: Chilika Lake, India and Laguna de Bay, Philippines. Chilika Lake is a unique estuary on the east coast of India south of Bhubaneswar. It is valued for its natural beauty, fisheries, tourism particularly due to its importance for migratory birds, and its importance for storing flood waters after monsoons. The protection of this natural resource is threatened by a number of factors: land-based pollution from the changing watershed which is seeing increased development and agricultural runoff, overfishing and aquaculture, irresponsible tourism, and sedimentation from monsoon flooding deposits.

Laguna de Bay is the largest inland waterbody in the Philippines, and it is adjacent to metro Manila. Laguna de Bay has many values including providing water for agriculture, industry, and drinking; supporting fisheries; providing recreational opportunities; and serving as a sanctuary for migratory birds. This multi-use resource is under threat from the densely populated and rapidly growing catchment. Eutrophication is a main concern. The lagoon receives untreated sewage and other nutrient pollutants from agriculture, industry, and mining. It also suffers from invasive species which threaten native fish and saltwater intrusion.

Addressing the Issues

In collaboration with local partners, the GNC project team developed ecosystem health report cards for Chilika Lake and Laguna de Bay to enhance understanding of the challenges and management of these important ecosystems. Ecosystem health report cards offer a way to effectively communicate monitoring data, social, and/or economic information against objectives in a manner that's easy to understand by scientists and citizens alike. Similar to academic report cards, they provide letters or numeric grades that reflect the status of the ecosystem. As such, they are an important tool to catalyze collaborative ecosystem management.

The development of ecosystem health report cards generally uses an empowering participatory approach with citizens and other stakeholders. Creating ecosystem health report cards starts with a local partner working in partnership with the University of Maryland Center for Environmental Studies (UMCES). When a long-term history of monitoring data is available, these data can be used as the foundation for the report card. The project team convenes broad stakeholder meetings to discuss the ecosystem's values and threats. These meetings help to inform the content of the report cards: what indicators are appropriate to communicate the perceived values and threats. A smaller advisory group may also be convened to help translate the data into easy-to-understand indicators and to inform the approach to setting thresholds and assigning the grades. Finally, a communications plan, established at the outset, will generally involve media outreach and a press release upon completion of the report card.

In Chilika Lake, the Chilika Development Authority had been conducting water quality monitoring data monthly for many years, but as is the case in many water bodies around the world, integration and interpretation of these data was limited. With help from the UMCES' Integration and Application Network (UMCES IAN), the project team initiated the process of leveraging this body of data to create the ecosystem health report card.

The Chilika Lake Ecosystem Health Report Card tracks the following indicators which are locally valued for fishing, tourism, biodiversity, etc.:

- Water quality: Chlorophyll *a*, dissolved oxygen, water clarity
- Biodiversity: bird count and richness, dolphin abundance, benthic fauna diversity, phytoplankton diversity
- Fisheries: total catch, commercial species diversity, size

The Chilika Development Authority invited the Laguna Lake Development (LLDA) Authority to also develop an Ecosystem Health Report Card for Laguna de Bay. LLDA had been closely monitoring the lake for years so had valuable data to start the development of a Report Card.

The Laguna de Bay Ecosystem Health Report Card tracks the following indicators which are locally valued:

- Water quality: nitrates, phosphates, chlorophyll *a*, dissolved oxygen, biological oxygen demand, and total coliforms
- Fisheries: zooplankton ratio, native fish species composition, and catch per unit effort

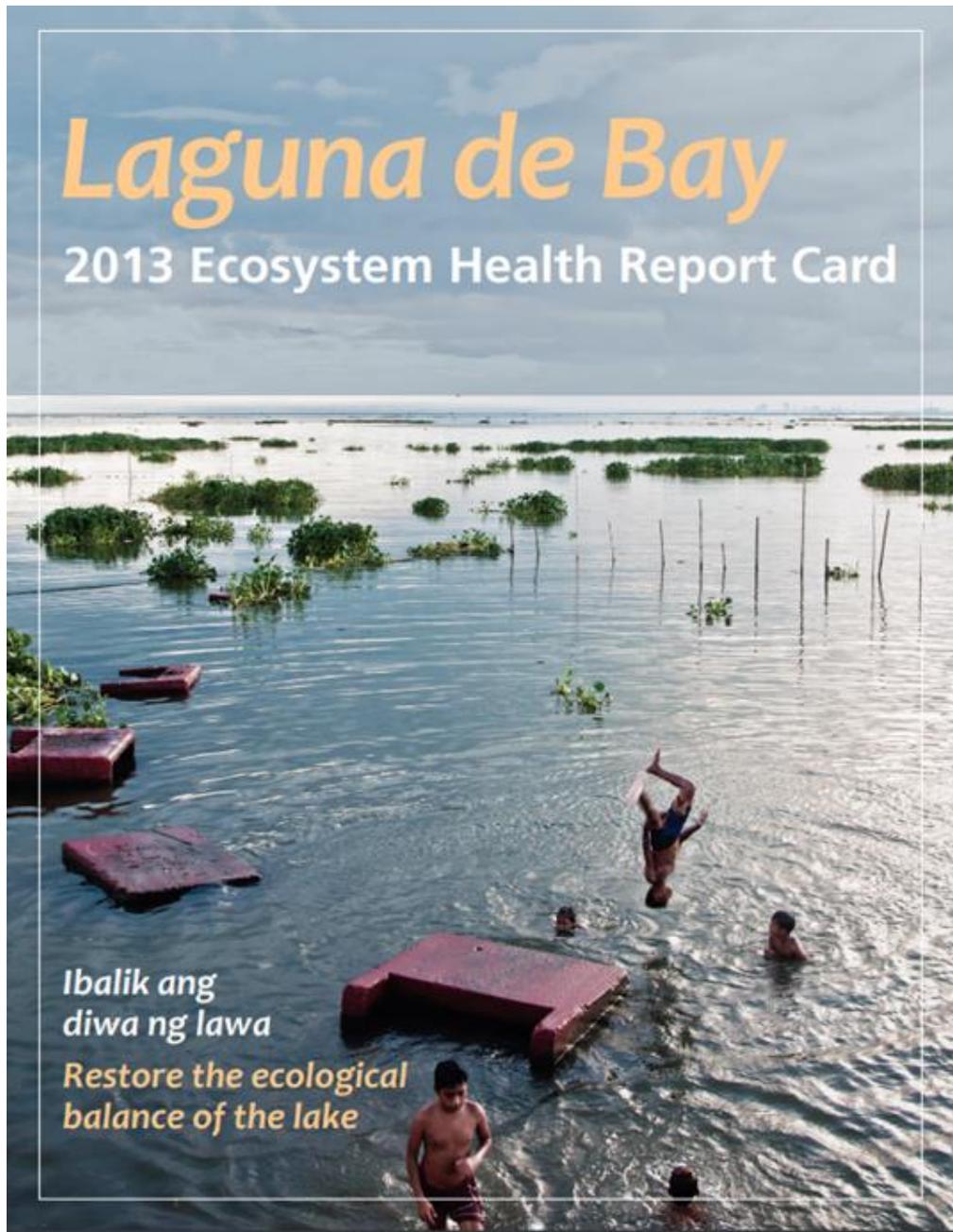


Figure 1. Front cover of 2013 Laguna de Bay Ecosystem Health Report Card

5. RESULTS AND LEARNING FROM EXPERIENCE

In Chilika Lake, the project team has observed an increase in awareness about the issues affecting the ecosystem. The report card captured the interest of the Chief Minister of Odisha, who is the chairperson of Chilika Development Authority. He asked to release the report card upon completion and encouraged a continued effort to release updated report cards biannually and use it as a monitoring and management tool. Moreover, he funded \$200,000 USD to the Chilika Development Authority to combat nutrient pollution. The report card made this grant possible by communicating the issues affecting Chilika Lake in a clear, concise five-page document with recommendations for interventions.

Chilika Development Authority acted, and continues to act, as an effective leader, taking ownership of the effort. CDA has continued to develop report cards over the years – it is now in its third iteration— and has adapted its internal operations accordingly.

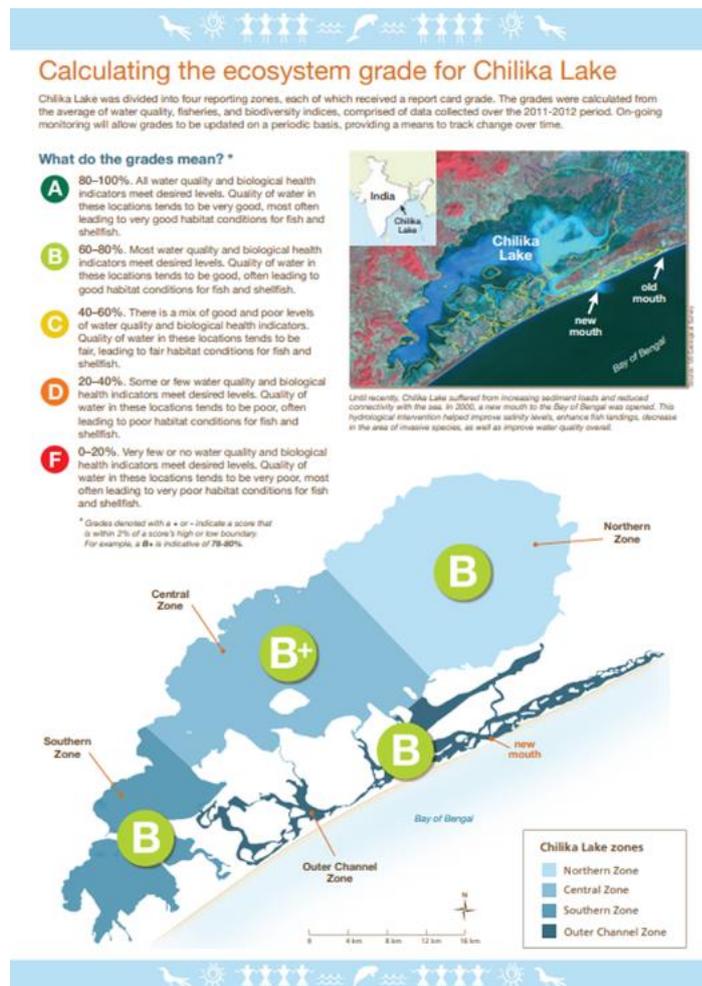


Figure 2. Inside page of 2012 Chilika Lake Ecosystem Health Report Card

According to UMCES IAN, the development of the Chilika Lake report card was unique in its pioneering success at engaging a contrastive dialogue among a wide variety of stakeholders from the beginning. And with high levels and diversity of engagement generally comes increased media attention. The UMCES team has observed a sense of shared ownership of the lake and its resources since the first report card was developed.

In Laguna de Bay, the report card is frequently referenced as being the best summary of the lake. Similar to in Chilika Lake, the report card development helped LLDA revisit their monitoring protocols

and approach. Although LLDA thought that it was data rich, their deep dive into the data and analysis sparked further interest in learning even more about the water body.

LLDA shared the report card with various stakeholder groups including fishermen, national government agencies, and private companies. One surprising finding in Laguna de Bay was that fishermen were open to sharing their data. The Report Card resonated with the fishermen when they viewed the poor grade that fisheries were rated. The local agencies lack sufficient data on fisheries, but the fishermen volunteered to share their catch data with LLDA.

As Laguna Lake Development Authority prepares the second iteration of the Report Card, it plans to conduct outreach with even more stakeholder groups including teachers and students, local governments, and the Department of Interior. LLDA hopes to include grades on local environmental governance in future iterations and also plans to speak with mayors and local executives specifically about how their respective rivers upstream of Laguna Lake are rated.

The story is starting to change in Manila. One stakeholder pointed out that Laguna Lake is often viewed as the biggest septic tank in Metro Manila. The residents know that it is dirty, so it is not treasured as a natural resource. LLDA is optimistic that the Report Card is serving to be a useful tool for changing this mindset.

Although outcomes are generally tracked over the long term, attributing improvements in water quality or ecosystem health back to report cards is challenging due to the multitude of factors and interventions at play. However, UMCES IAN reports that of the past projects that have been surveyed, more than half of respondents believed that positive changes in the ecosystem could be attributed to the report card. And 80 percent of respondents attributed greater awareness of key issues to the report card.

6. REPLICATION

The Chilika Lake and Laguna de Bay report cards can indeed be replicated by others. In fact, these report cards are just two of many report cards that have been developed around the world under UMCES IAN's leadership. And Chilika and Laguna Lake Development Authorities are sharing their experiences with experts working on Lake Naivasha, Kenya through a technical exchange.

While there are many resources and much expertise on this topic to enable replication, developing report cards like these does not come without challenges. One primary challenge is creating and funding a sustainable model for continuing assessments on an annual basis. Creating only one report card, while valuable for a snapshot in time, falls short of being a useful resource for tracking changes in the ecosystem and its management over time. A local government or other champion with devoted funding is critical for ensuring sustainability. GEF's support for this effort is critical to address this challenge.

Another challenge, which is an important enabling condition, is having sufficient high-quality data. Ecosystems should have long-term monitoring of at least a few years to establish a baseline condition representative of long-term weather trends. If there are data gaps, modeling may need to be conducted to help parse together the full picture.



Figure 3. Participants of the Water Pollution Assessment Tool Technical Exchange in Lake Naivasha, Kenya

Translation into local languages is also critical to ensure the report cards reach a broad audience. For example, in Chilika Lake, the report card was translated to the local language so fishermen could read it. As critical stakeholders who live on the lake, having the fishermen participate in the process and understand health of the lake on which they depend and impact is critical to the long-term success of the report card's reach.

UMCES IAN, together with the World Wildlife Fund, published a handbook on creating river basin report cards. This handbook is largely applicable to ecosystems like Chilika Lake and Laguna de Bay as well. In short, this handbook identifies five enabling conditions that are paramount to the success of a report card's development and outcomes:

1. Demand: Stakeholders identify a need for a report card and are willing to take ownership. This can be achieved through stakeholder convenings.
2. Politics: Government officials should be included. Their involvement increases the likelihood that the report card's findings are acted on.
3. Funding: Financial and human capital are critical for developing a report card, particularly for the first publication.
4. Leadership: As with any dynamic and collaborative project, a strong leader by an individual or team is essential.
5. Media: A report card can drive real-world outcomes in ecosystem management if its results are communicated to the right change makers. Proactive communications throughout the development of the report card helps increase the likelihood of success.

For anyone interested in developing an ecosystem health report card, UMCES IAN and veteran local partners are available for guidance.

7. SIGNIFICANCE

In many parts of the world, nutrient pollution fails to receive the attention that it deserves. These ecosystem health report cards help to communicate the issues in a way that the local populations who live on and depend on the resource, policy makers, and scientists can all understand. Furthermore, the report cards have the potential to be linked to intermediate goals tied to Sustainable Development Goals.

The outcomes that have been achieved in Chilika Lake, Laguna de Bay, and around the world demonstrate the effectiveness of these report cards and the importance of GEF continuing to fund these efforts, both continued efforts in places like Chilika Lake and Laguna de Bay, and in new ecosystems.

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- UMCES ecosystem health report card team:
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- Contact: Lennie Santos-Borja, lennieborja@yahoo.com
- Report card: <http://pemsea.org/publications/reports/laguna-de-bay-2013-ecosystem-health-report-card>

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- Contact: Ajit Pattnaik, ajitpattnaik13@gmail.com (retired)
- Report card: <https://bit.ly/2GeMJBW>

9. KEYWORDS

- nitrogen
- phosphorus
- water pollution
- ecosystem health cards
- environmental indicators

Project partners:





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Abstract: The Global Nutrient Cycle project was designed to provide foundations 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. This experience note focuses on the activity of developing a local adaptation of the Global NEWS Model for Manila Bay to better simulate site-specific conditions. Decision-support tools and models, such as the Global NEWS model, help to capture current nutrient pollution loading and predict future nutrient exports. However, these resources are limited at the local level where this critical information is also needed to protect local water quality and help meet SDGs. The Manila Bay catchment suffers from excess nutrients, and The University of the Philippines Marine Science Institute (UPMSI) and Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) were interested in quantifying the nutrient loadings, and the impacts of those loadings, to help policy makers decide on the best way to solve the problem. This effort demonstrates the effectiveness of partnerships between global, technical experts and local experts at developing tools using best available methodologies and data to meet local needs. In addition, the downscaling of the Global NEWS Model had broad-reaching results beyond Manila Bay. The project team trained representatives from eight other countries on the downscaling exercise, demonstrating the potential for replicability in other catchments around the globe.

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UN Environment and the Global Partnership on Nutrient Management

1. TITLE

Scaling Down the Global Nutrient Export from WaterSheds (NEWS) model to a Local Setting: Manila Bay Case Study

2. PROJECT TITLE

“Global Foundations for reducing nutrient enrichment and oxygen depletion from land-based pollution in support of Global Nutrient Cycle”

GEFSEC Project ID: 4212

GEF Agency Project ID: 576

3. PROJECT DESCRIPTION

The overarching objective of this four-year project, known as the “Global Nutrient Cycle (GNC)” project was to provide the foundations (including partnerships, information, tools and policy mechanisms) for governments and other stakeholders to initiate comprehensive, effective and sustained programmes addressing nutrient over-enrichment and oxygen depletion from land-based pollution of coastal waters in Large Marine Ecosystems.

The Global Partnership on Nutrient Management (GPNM) designed and led the project around four components:

- Component A: Global Partnership on Nutrient Management addresses causes and impacts of coastal nutrient over-enrichment and hypoxia
- Component B: Quantitative analysis of relationship between nutrient sources and impacts to guide decision making on policy and technological options
- Component C: Establishment of scientific, technological, and policy options to improve coastal water quality policies in LMEs and national strategy development
- Component D: Development of nutrient reduction strategies through application of quantitative source-impact modeling and best practices in Manila Bay watershed

This experience note will focus on the activity of developing a local adaptation of the Global NEWS Model for Manila Bay to better simulate site-specific conditions.

The development of the local Manila Bay Nutrient Load Model involved the expertise of modelers proficient in the Global NEWS Model (Utrecht University) and modelers with local expertise on data and modeling (University of the Philippines).

The Manila Bay Nutrient Load Model was designed to:

- estimate the nutrient load to Manila Bay from domestic, agriculture, and aquaculture activities;
- determine the efficiency of sewage connections, treatment, and phosphorus reduction in detergents through different scenario runs; and
- suggest possible policies or strategies for nutrient load reduction based on the results of the different scenario model runs.

The Model was employed in Manila Bay to inform local stakeholders and policymakers and was demonstrated through a week-long training to other practitioners from other countries in a South to South learning exchange.

4. DESCRIPTION OF ISSUE(S), CHALLENGE(S) AND EXPERIENCE

The Issues

Nutrients, nitrogen and phosphorus, are critical for growing crops and feeding the world. However, too many nutrients can be harmful to the environment. Human activities produce around 120 million tonnes of reactive nitrogen each year, two thirds of which goes unused and pollutes the world’s water quality, air quality, greenhouse gas balance, ecosystems, and soil quality. Anthropogenic mined phosphorus is also added to the natural cycles. Although phosphorus is a finite resource, nearly half of what is produced goes unutilized and enters waterbodies as a pollutant.

Nitrogen and phosphorus fertilizer use has increased substantially since the 1960s and is projected to increase by 40-50% through 2050 in order to feed the planet's growing population. We face a nutrient challenge to produce more food and energy while at the same time decreasing our pollution and lifting more than 500 million smallholder farmers in developing countries out of poverty. How we handle this challenge has significant implications for our ability to meet the Sustainable Development Goals (SDGs), produce enough food while protecting our environment and health, and reducing poverty.

Decision-support tools and models, such as the Global NEWS model, help to capture current nutrient pollution loading and predict future nutrient exports. However, these resources are limited at the local level where this critical information is also needed to protect local water quality and help meet SDGs.

Addressing the Issues

The GNC project targeted Manila Bay as a priority catchment due to its nutrient-loading problem which results in eutrophication and hypoxia in the Bay. The metropolitan area of Manila is densely populated, and less than 30 percent of the population is connected to sewage treatment. In 2008, the Supreme Court ruled that government agencies need to clean up the Bay and have to submit quarterly reports on their progress. The University of the Philippines Marine Science Institute (UPMSI) and Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) were interested in quantifying the nutrient loadings, and the impacts of those loadings, to help policy makers decide on the best way to solve the problem.

A partnership was formed between the UPMSI and Utrecht University, who developed the Global NEWS model, to work together to downscale the relatively coarse Global NEWS Model to a watershed scale more appropriate for use in Manila Bay. This new model, the Manila Bay Nutrient Loading Model, is a Python-based tool for simulating a more localized geography by acquiring and using local data. It uses a combination of urban, agriculture, and water transport models to calculate nitrogen and phosphorus pathways per grid cell. Data inputs of population, livestock, fertilizer use, fish stocks, etc. inform the suite of models. Weightings of the loads are done per grid cell based on land use maps.

To run the Manila Bay Nutrient Loading Model, the project team used most of the methodologies from the Global NEWS Model, making a few revisions to be more site-specific. For example, the project team added the simulation of household septic tanks due to their prevalence in Manila. In addition, wherever local data were available, maps of the Manila Bay watershed were translated from the original 10x10 km grid to a 1x1 km grid. Global input files were replaced with local datasets such as on population, fertilizer use, production, and connection to sewage system. These changes produced more accurate, finer resolution results about nutrient loading in Manila Bay than was possible with the Global NEWS Model.

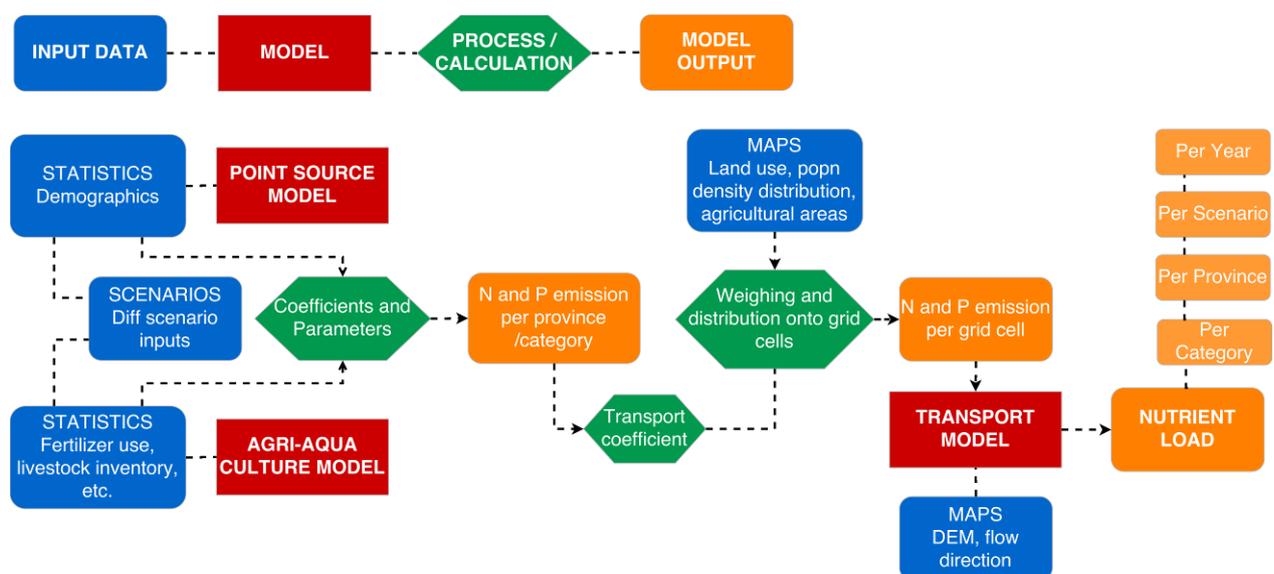


Figure 1. Nutrient Load Model overview

The Manila Bay Nutrient Loading Model was also developed with functionality to simulate future scenarios in order to help inform policy makers on options for meeting the Philippines' Supreme Court ruling for government agencies to clean up Manila Bay and meet nutrient discharge limits.

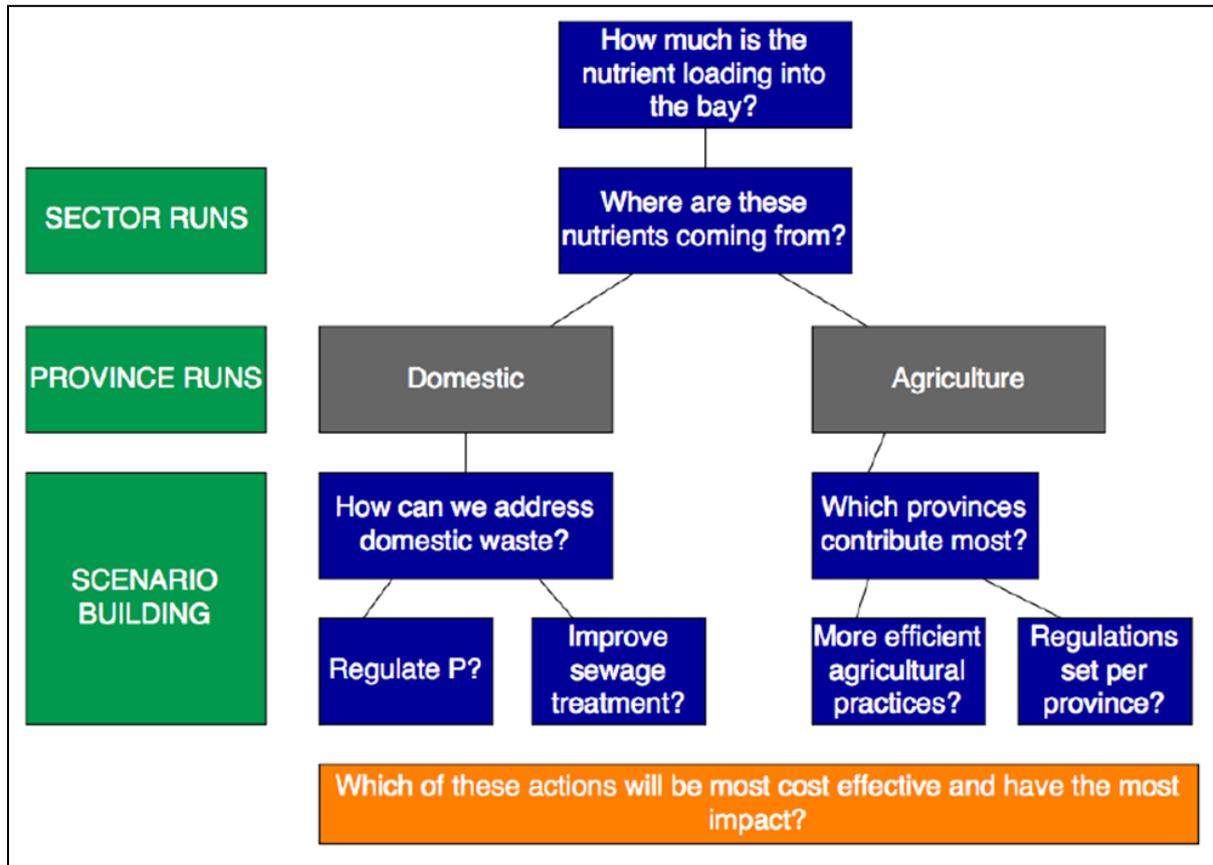


Figure 2. Nutrient Load Model future scenario building schematic

5. RESULTS AND LEARNING FROM EXPERIENCE

This effort demonstrates the effectiveness of partnerships between global, technical experts and local experts at developing tools using best available methodologies and data to meet local needs. This partnership would not have been possible without the facilitation of the GPNM.

The Manila Bay Nutrient Loading Model simulation generated key findings about the local nutrient problem and possible solutions:

- Unlike in many developed countries where eutrophication is closely linked to agricultural discharge, the Model suggests that it is urban runoff and sewage from Metro Manila, a densely populated megacity, that is primarily fueling the nutrient loadings into Manila Bay.
- The Model suggests that a ban on phosphorus-based detergents could significantly reduce phosphorus loadings to Manila Bay in the short term without requiring tertiary treatment by the sewage treatment plants.

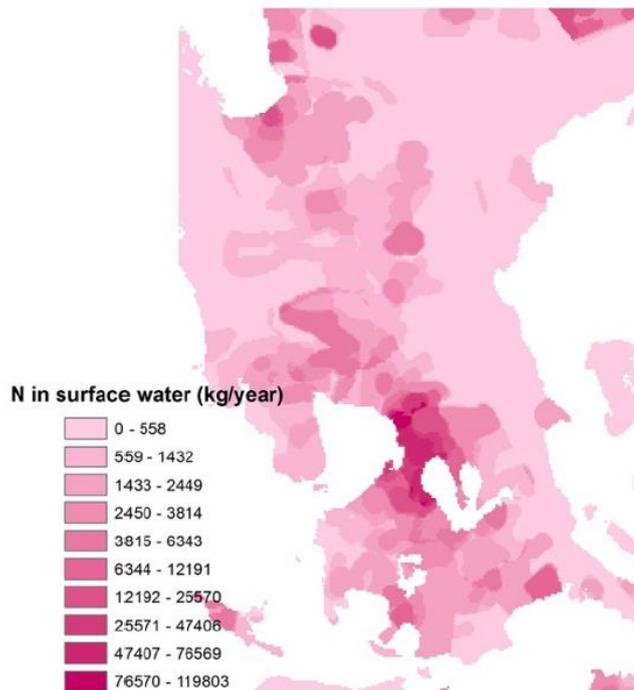
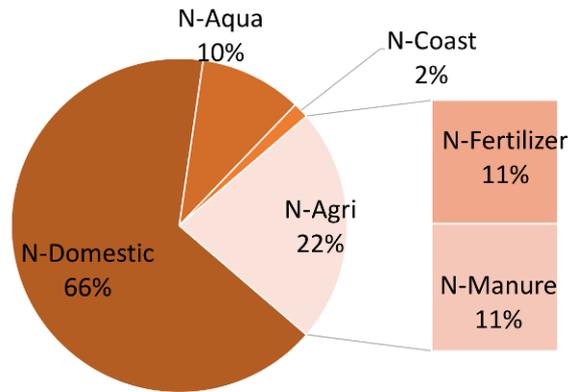


Figure 3. Sample results of nitrogen loading sources from the Nutrient Load Model

The project team shared these findings with policy makers at the Environmental Management Bureau and helped generate an impressive outcome. The Environmental Management Bureau later revised water quality guidelines and standards that for the first time, included targets for nitrogen and phosphorus for various sectors.

In addition, the downscaling of the Global NEWS Model had broad-reaching results beyond Manila Bay. The project team hosted a workshop in Manila for 11 participants who represented 8 different countries. Some of these countries, including China and Sri Lanka, were facing nutrient pollution problems in their watersheds, and participants were eager to learn about the Model and its potential application in their local watersheds. By the end of the workshop, participants had the skills to calculate their respective watersheds' nutrient loadings and to simulate future scenarios, for example with increased sewage treatment.

6. REPLICATION

This project has already started the process of replicating the exercise in other areas through the global training event in Manila. This experience was not without challenges. The following considerations should be carefully reviewed before continuing this effort or conducting a similar exercise:

- Although the Manila Bay Nutrient Loading Model was designed to be relatively user friendly for local government officials, there is still a basic level of technical competency that is required. The Manila workshop got off to a slow start given technical challenges that the participants experienced prior to and during the workshop.
- Currently, the Model has 3 modules that run separately: a point source/urban waste flow model, an agriculture and aquaculture model, and a water transport model. These separate modules create layers of complexity for the user.
- The accuracy of the down-scaled Model depends on the availability of local data. Global datasets such as from the Food and Agriculture Organization can be used where local data are not available.
- The outcome of the down-scaled model on water quality policy is dependent on having a receptive government or private sector who's willing to act on the findings by adopting policies or changing behavior to reduce excess nutrients.

With these challenges recognized, there are a few specific conditions that should be in place if others are to replicate the down-scaling of the Global NEWS Model for their local watersheds:

- Cooperation from both the global and local modeling/programming experts is critical for the exercise to be successful and results valid.
- Local datasets on variables such as population, fertilizer use, crop production, sewage treatment, and land use are necessary to customize the model to suit local conditions.
- Although a local nutrient loading model can be useful for conserving good water quality, the participants in the workshop who represented areas with poor water quality were the most eager to adopt the approach for their watersheds.
- Likewise, having a receptive local, provincial, or national government who's exploring, or enforcing, nutrient reduction measures will make the model a valuable and timely asset that can help to generate real, measurable outcomes.

And finally, to use a local nutrient modeling to catalyze real change, the project team observed that having a committed group of partners who can champion the issue will help advance solutions. These champions, in turn, should sell the need for reducing nutrients not simply for the sake of reducing nutrients but because of the detrimental impacts on fisheries, aesthetics, or harmful algal blooms which people can relate to.

7. SIGNIFICANCE

Nutrient pollution does not receive enough attention on the global agenda, particularly in developing countries. Global models can help to illustrate the nutrient challenge, but they are not well-suited to address local or regional problems. This case study provides a pathway to adapt the Global NEWS model for a small catchment, Manila Bay, to explore, confirm, and estimate nutrient sources and loads; identify problem areas; and build alternative future scenarios to evaluate policy options for reducing nutrients.

This exercise is perhaps most significant to GEF and transboundary water resources management in its link to the SDGs. SDG 14.1 aims to reduce marine pollution from land-based activities by 2025. To address marine pollution such as eutrophication, countries need to first understand their nutrient loads and their impact on eutrophication, and then they need to understand what they can do to address the issue. Models like this one, complemented with local data, can provide a first-order estimate of nutrient loadings and the effects of various interventions on such loadings. More investments in decision-support tools like this one will be critical for countries to implement strategic plans for achieving SDGs and other commitments.

8. REFERENCES

- GPNM secretariat contact info: Christopher Cox, christopher.cox@un.org, UN Environment Global Programme of Action
- Website for the Global Nutrient Cycle Project: www.Nutrientchallenge.org
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9. KEYWORDS

- Nutrients
- nutrient management
- decision-support tool
- modeling
- land-based pollution

Project partners:

