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

Global Nutrient Cycle

Global Nutrient Management Toolbox

Promotional resources

Prepared by: World Resources Institute

Component C: Doc: C5-2

Partners:

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About the GEF-Global Nutrient Cycle Project

Project objective: to provide the foundations (including partnerships, information, tools and policy mechanisms) for governments and other stakeholders to initiate comprehensive, effective and sustained programmes addressing nutrient over-enrichment and oxygen depletion from land based pollution of coastal waters in Large Marine Ecosystems.

Core project outcomes and outputs:

- the development and application of quantitative modeling approaches: to estimate and map present day contributions of different watershed based nutrient sources to coastal nutrient loading and their effects; to indicate when nutrient over-enrichment problem areas are likely to occur; and to estimate the magnitude of expected effects of further nutrient loading on coastal systems under a range of scenarios
- the systematic analysis of available scientific, technological and policy options for managing nutrient over-enrichment impacts in the coastal zone from key nutrient source sectors such as agriculture, wastewater and aquaculture, and their bringing together an overall Policy Tool Box
- the application of the modeling analysis to assess the likely impact and overall cost effectiveness of the various policy options etc brought together in the Tool Box, so that resource managers have a means to determine which investments and decisions they can better make in addressing root causes of coastal over-enrichment through nutrient reduction strategies
- the application of this approach in the Manila Bay watershed with a view to helping deliver the key tangible outcome of the project – the development of stakeholder owned, cost-effective and policy relevant nutrient reduction strategies (containing relevant stress reduction and environmental quality indicators), which can be mainstreamed into broader planning
- a fully established global partnership on nutrient management to provide a necessary stimulus and framework for the effective development, replication, up-scaling and sharing of these key outcomes.

Project partners:

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

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

GLOBAL NUTRIENT MANAGEMENT TOOLBOX

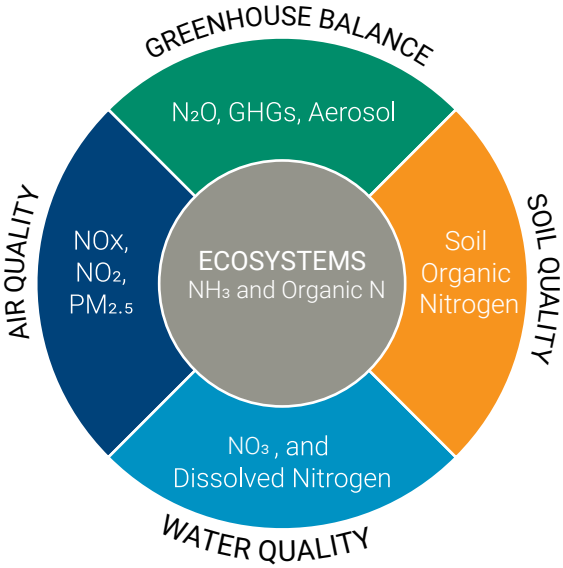
The Global Nutrient Management Toolbox is a suite of databases, information, and tools that support actions and policy decisions related to managing nutrients to minimize environmental degradation.

OCTOBER 2018

BACKGROUND ON THE NUTRIENT CHALLENGE

Nutrients, nitrogen and phosphorus, are critical for growing crops and feeding the world. However, too many nutrients can harm the environment. Human activities generate around 120 million metric tons of reactive nitrogen each year, two-thirds of which goes unused and pollutes the world's waters and air, contributes to greenhouse gas potential, degrades ecosystems, and negatively impacts soil quality in many regions. 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. On the other hand, some regions, particularly in Africa and parts of Asia and Latin America, do not have enough nutrients to meet their agricultural needs. Soil may be mined, leaving more nutrients extracted than replaced.

There are five key threats stemming from excess or insufficient nutrients which can be referred to as the "WAGES":



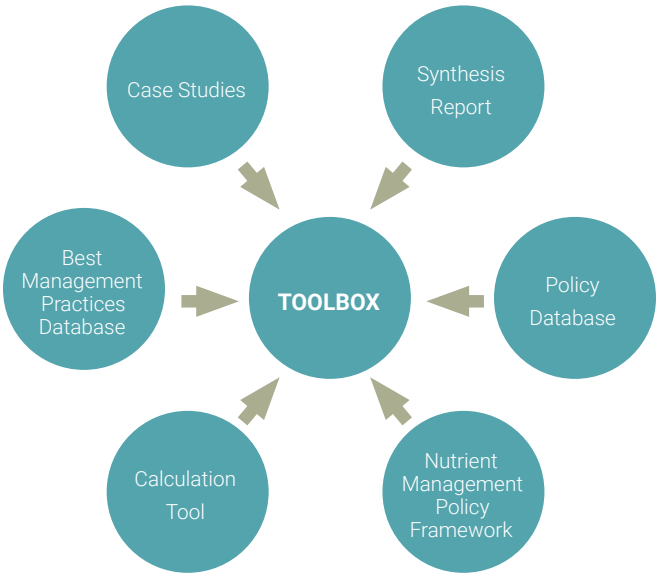
- **W***ater quality*. Excess nutrients running off farm land, cities and discharged from sewage treatment plants create eutrophic conditions which can spur algal blooms. There are more than 500 coastal areas across the globe estimated to be suffering from eutrophication.
- **A***ir quality*. Nitrogen in the form of nitrogen oxide (NO_x) and nitrogen dioxide (NO_2) are emitted by power plants and vehicles and contribute to smog, ozone, acid rain and human health issues.
- **G***reenhouse gas balance*: Nitrogen in the form of nitrous oxide (N_2O) is emitted into the atmosphere from agricultural activities and fuel combustion. N_2O is a greenhouse gas with more than 200 times the global warming potential as carbon dioxide.
- **E***cosystems and biodiversity*: The effects of eutrophication and atmospheric deposition can harm the biodiversity of natural ecosystems. Algae that thrive in eutrophic conditions block out sunlight and consume oxygen, leaving behind dead zones where fish cannot survive.
- **S***oil quality*: Excess fertilizer and manure can acidify soils, reducing their quality for crop production. On the other hand, some areas have insufficient nutrients and a lack of fertilizer. Crop harvests without replenishment of necessary nutrients may degrade soils.

The Global Partnership on Nutrient Management developed a Global Nutrient Management Toolbox to increase attention to and drive action around sustainably managing nutrients across various sectors—agriculture, urban, wastewater and energy. The Toolbox is a collection of promising practices, technologies and policies in use around the globe, and it provides a basin-scale model to assess current loads and simulate future scenarios. 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.

Nitrogen and phosphorus fertilizer use has increased substantially since the 1960s and is projected to increase by 40-50 percent 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.

EXPLORE THE GLOBAL NUTRIENT MANAGEMENT TOOLBOX

The toolbox serves as an information portal on the subject of nutrient management, providing three kinds of resources: (1) searchable databases of more than 200 nutrient management practices and policies in use around the world, (2) case studies and reports on how priority best practices are being implemented to achieve nutrient management objectives, and (3) a calculation tool for assessing a river basin's current and potential future nutrient load based on changes in management actions. The Toolbox is a valuable resource for policy makers, extension agents, and other professionals and practitioners across the agriculture, aquaculture, wastewater and urban sectors.



Nutrientchallenge.org/gpnm-toolbox

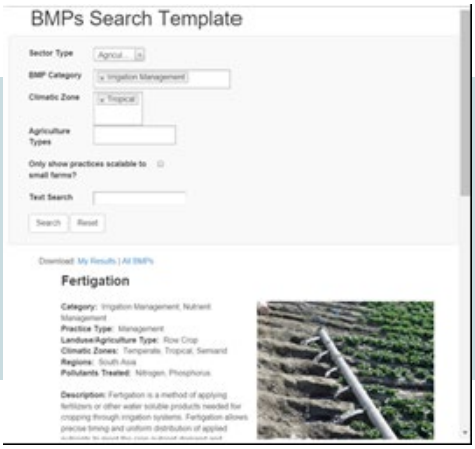
The Global Nutrient Management Toolbox was developed by Global Partnership on Nutrient Management partners—the World Resources Institute, the Energy Research Centre of the Netherlands and the Global Environment and Technology Foundation—to demonstrate effective practices and policies for nutrient management.

The Toolbox was developed with funding support from the Global Environment Facility through the Global Foundations for Reducing Nutrient Enrichment and Oxygen Depletion from Land-Based Pollution, in Support of the Global Nutrient Cycle (GEF-GNC) Project.

IN THE TOOLBOX

SEARCH DATABASES FOR BEST PRACTICES AND POLICIES

Search a best management practice and policy database for 200+ management options and approaches to reduce nutrient losses. Databases are searchable by sector, practice or policy type, and climatic zone. Results include descriptions of the practices and policies, anticipated or achieved outcomes, and considerations for adoption.



LEARN ABOUT NUTRIENT MANAGEMENT EFFORTS

Learn about eight best practices for sustainable nutrient management, their use in locations that are 'nutrient hot spots'—areas that are impacted by adverse effects of poor nutrient management—and their scalability in other parts of the world. Explore 20+ case studies on what others are doing to achieve their nutrient management objectives and what they've achieved.

CALCULATE NUTRIENT LOADS IN YOUR RIVER BASIN

Use the Toolbox Calculator, powered by the Global NEWS model[a], to estimate nutrient loads in major river basins around the world. Run future scenarios to explore the nutrient loading implications of management decisions such as implementing agricultural best management practices or increasing sewage treatment.

[a] nutrientchallenge.org/nutrient-export-land-sea-global-news

WHO SHOULD USE THE TOOLBOX?

- *Policy makers*: With experiential information on national and regional policies and pilot efforts for managing nutrients from around the world, policy makers from various sectors can use the toolbox to learn from others as they explore opportunities for sustainable nutrient management in their own geography. The Synthesis Report and Case Studies explore how key practices and approaches have fared in select regions around the world. The Toolbox Calculator can also inform policy makers about their risk of coastal eutrophication and help them explore alternative management scenarios for reducing nutrient loadings.
- *Agricultural extension agents*: The Best Management Practice (BMP) Database contains examples of best management practices for reducing excess nutrients and sediment from land-based sources such as crop fields and pasture. Extension agents can use the database to identify and evaluate options for implementing agricultural practices, consider costs and discover applicability to smallholder farms.
- *Stormwater managers*: The BMP Database and Policy Database include management practices and approaches for addressing nutrient loadings from urban land uses. These practices can be evaluated for applicability to various climatic zones or regions, making them a useful resource for stormwater managers around the world.
- *Wastewater managers*: The Policy Database highlights various approaches for addressing nutrient loadings from wastewater, from regulatory caps to flexible approaches for cost effectively meeting permit limits.
- *Watershed organizations*: Watershed organizations can use the Case Studies and other Toolbox resources to explore innovative approaches for nutrient management from around the globe. In addition, the Toolbox Calculator operates at a river basin scale and provides data on nutrient loads by sector. It also gives the user the ability to run alternative management scenarios to explore options for reducing nutrient loads and eutrophication risk in coastal waters.
- *Private sector*: Private sector stakeholders, such as multinational companies sourcing raw ingredients or operating facilities which produce effluent discharge, can use the Toolbox's Policy Database to research approaches that others in the private sector have taken to reduce their nutrient footprint and market their products accordingly. The Toolbox Calculator can also be used to review nutrient loads and water quality impacts across watersheds in which companies are active.

USING THE TOOLBOX TO MEET SDGS

Sustainable nutrient management is embedded in various Sustainable Development Goals (SDGs). For example, good nutrient management can improve soils and yields, thereby increasing food production and economic development. It can help protect ambient water quality and ecosystems. And SDGs for responsible consumption and production, sustainable cities and climate action can all provide co-benefits for nutrients.

END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION AND PROMOTE SUSTAINABLE AGRICULTURE | *Nutrient use efficiency, where applications of fertilizer are in balance with plant uptake to minimize losses, can help achieve Target 2.4 of sustainable food production systems.*

ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL | *Targets 6.3 aimed at reducing water pollution and 6.a aimed at supporting wastewater treatment and reuse are strongly linked to minimizing nutrient leakage to the environment.*

ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS | *Targets 12.2, 12.4, and 12.5 aim to sustainably manage natural resources, chemicals, and waste. The sound management, including reducing and reusing, of both phosphorus – a finite resource - and nitrogen can help prevent their release to air, water, and soil.*

TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS | *In development of their national policies and strategies to address climate change and meet Target 13.2, national governments should include plans to manage nitrous oxide.*

CONSERVE AND SUSTAINABLY USE THE OCEANS, SEAS AND MARINE RESOURCES FOR SUSTAINABLE DEVELOPMENT | *Nutrient pollution is explicitly mentioned in Target 14.1 to prevent and reduce marine pollution from land-based activities.*

PROTECT, RESTORE AND PROMOTE SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS, SUSTAINABLY MANAGE FORESTS, COMBAT DESERTIFICATION, AND HALT AND REVERSE LAND DEGRADATION AND HALT BIODIVERSITY LOSS | *Nutrient use efficiency can help to achieve Target 15.3 by preventing crop harvests from depleting soils of nutrients, thereby helping to avoid land degradation.*

As countries strive to meet these SDGs, the Toolbox can be a valuable resource for exploring options to protect freshwater and marine resources while maintaining or increasing food production and economic development. Of particular interest is SDG 14 which calls for countries to "conserve and sustainably use the oceans, seas and marine resources for sustainable development." Within this goal, target SDG 14.1 aims to reduce marine pollution from land-based activities, including nutrient pollution by 2025. The Index of Coastal Eutrophication Potential (ICEP), which uses information on riverine nutrient loads to estimate the potential for eutrophic conditions to develop in the coastal zone, is one of the indicators for monitoring this target. The

Toolbox Calculator provides an ICEP score for about 6,000 river basins globally and allows the user to evaluate how this ICEP value would change under alternative management scenarios that change nutrient discharges, like halving untreated wastewater or reducing fertilizer applications.

ADAPTING THE TOOLBOX TO LOCAL CONDITIONS

The Toolbox was designed to have global application, but differences in climate, landscape, politics, economy and other factors can affect the suitability of directly applying the information in the Toolbox to decision making. To facilitate this process, there are various components of the Toolbox that allow the user to customize the inputs or results.

- *BMP and Policy Database*: Search filters allow the user to search for BMPs and policies that are relevant to their individual criteria. For example, users can choose to search for results that apply to certain regions, sectors or climatic zones.
- *Toolbox Calculator*: Users can replace the default global datasets with more accurate local data when available. Inputs may include population, fertilizer use, connection to sewage and septic systems, and geospatial maps of land use and population density. Future scenarios may also be run to explore the potential effects of locally proposed policies and land use changes. The box below gives an example of adapting of one of the toolbox functionalities to a more local setting.

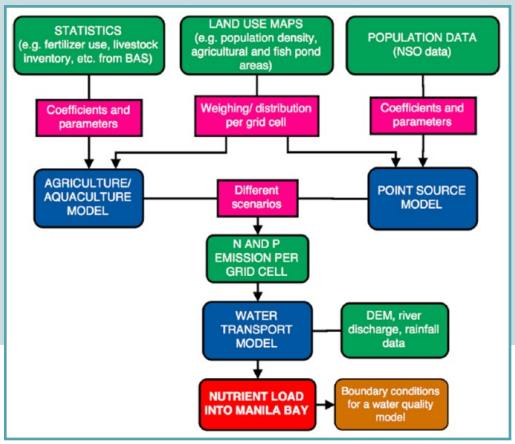
Scaling Down the Toolbox Calculator to a Local Setting: Manila Bay Case Study

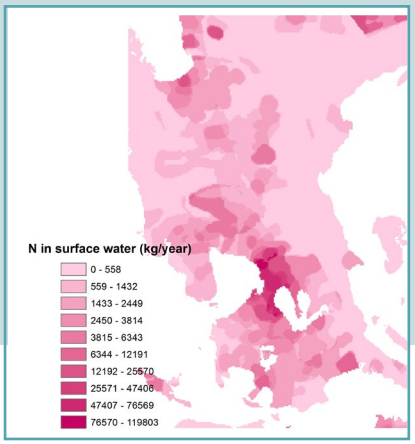
Researchers from the University of the Philippines scaled down the Global NEWS Model, which powers the Toolbox Calculator, to develop the Manila Bay Nutrient Load Model. The Nutrient Load Model (1) estimates the amount of nutrient load to Manila Bay from various sources, (2) determines the efficiency of sewage connections, treatment, and phosphorus reduction in detergents, and (3) identifies possible policies or strategies for nutrient load reductions.

Data on population, fertilizer use, wastewater production and treatment and other inputs were obtained from the Philippine Statistics Authority and Bureau of Agricultural Statistics. The model was run using a combination of these localized data, where available, and the default global data. It was used to evaluate the current nutrient load amounts and sources and to explore the nutrient loading reduction potential of policy actions for consideration by relevant national authorities in the Philippines.

The researchers identified where in the basin nutrients are coming from and distinguished the proportion of loads by source. Domestic sources were the primary contributor of nutrient loadings to Manila Bay, and loads are only projected to increase. Therefore, sewage treatment should be the focus for reducing nutrient loads. Scenarios suggested that a ban on phosphorus in detergents would help reduce phosphorus loads as much as tertiary treatment, but at a lesser cost.

Similar exercises can be conducted in other regions around the world where input data are available.





CONSIDERATIONS WHEN USING THE TOOLBOX

The Global Nutrient Management Toolbox is designed to be a 'go-to' resource to aid decision makers around the world in the promotion of more sustainable nutrient management practices. Due to variations across geographies and sectors, knowledge gaps, and a variety of other factors, users of the Toolbox should consider the following:

- The information collected, particularly for the databases, was largely based on what was easily locatable online and, in this regard, will not consider all possible scenarios.
- Information sources were largely limited to those in English and by extension from English-speaking countries.
- Availability of cost estimates for implementation of improved nutrient management practices is an important consideration for promotion and adoption of best practices and policies, but information is limited. Further, cost estimates where available may not translate easily to other regions.
- The Toolbox resources are largely focused on nutrient management in agriculture, with less information about other sectors like transport, fisheries, etc.
- The Toolbox is designed primarily to help decision-makers address problems of excess nutrient leakage to the environment, and utility for decision making for areas with challenges associated with nutrient deficits may be limited.
- The Nutrient Calculator uses global datasets which may not be as accurate as finer-resolution local data, and lacks locally specific BMP efficiencies.

OPPORTUNITIES FOR ENHANCEMENTS

The Global Partnership on Nutrient Management aims to continue to enhance the Toolbox functionality over time based on feedback from the user community and GPNM partners.

Potential future enhancements include:

- Updating the Toolbox with recent learnings or new approaches. The intention is to continue to populate the database through user and GPNM partner contributions.
- Expanding the search capabilities to other languages. The GPNM will continue to rely on the user community to contribute resources in native languages.
- Adding a Toolbox Calculator optimization feature that allows for entry of user-specified management options based on location-specific data to evaluate nutrient load scenarios.
- Building an enhanced analytical link between the BMP and Policy Database and the Toolbox Calculator to be able to evaluate nutrient load scenarios from implementation of selected BMPs and policies.
- Incorporating additional information about costs and regional applicability of management options.

About the Global Partnership on Nutrient Management

The accelerated use of nitrogen and phosphorus is at the center of a complex web of development benefits and environmental problems. The Global Partnership on Nutrient Management (GPNM) aims to address the nutrient challenge of how to reduce the amount of excess nutrients in the global environment while promoting sustainable global development. The GPNM reflects a need for strategic, global advocacy to trigger governments and stakeholders in moving towards lower nitrogen and phosphorous inputs to human activities. It provides a platform for governments, UN agencies, scientists and the private sector to forge a common agenda, mainstreaming best practices and integrated assessments, so that policy making and investments are effectively nutrient-proofed. The GPNM also provides a space where countries and other stakeholders can forge more cooperative work across the variety of international and regional fora and agencies dealing with nutrients, including the importance of assessment work.

Get Started

To learn more or to use the Global Nutrient Management Toolbox, visit: **nutrientchallenge.org/gpnm-toolbox**.

Contact

For more information on GPNM and the toolbox, please contact:

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Funders

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