AGENDA 2030
Helping to
Transform our World

Plant Nutrients and Ocean Health

The fertilizer industry is fully committed and engaged to contribute to the implementation of Target 14.1 of the Sustainable Development Goals (SDGs): *"By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution."*

Key Messages:

- Eutrophication, the excess growth of algae and phytoplankton in water bodies due to their enrichment with plant nutrients, and aquatic hypoxia (oxygen deficiency in water) have been identified in recent years as a significant source of marine pollution, in particular in coastal areas.
- Eutrophication can be triggered by natural causes, but plant nutrients also make their way into coastal waters from man-made sources, including industrial and urban wastewater, and agricultural run-off; eutrophication can be reinforced by other factors such as rising water temperatures due to climate change.
- Plant nutrients – in the form of both manure and mineral fertilizers – applied by farmers to their fields, play a crucial role in enhancing agricultural yields, but some of these nutrients can make their way into nearby streams, and end up in rivers, lakes and coastal areas through agricultural runoff of soils caused by heavy rainfall and improper soil and crop nutrient management practices.
- It is important to control pollution from "point sources", such as industrial and urban wastewater treatment sites, as well as to reduce nutrient losses from "non-point sources," i.e. from diffuse sources within a watershed.
- The fertilizer industry is cognizant of the role of fertilizers in nutrient losses to water (and more broadly to the environment) and is actively engaged to reduce such losses. Nutrient losses can be minimized when best practices in both farm, and more specifically, fertilizer management are applied.

Nutrient losses to coastal waters

A. Eutrophication and hypoxia

Eutrophication, the excess growth of algae and phytoplankton in water bodies due to their enrichment with plant nutrients, and aquatic hypoxia (oxygen deficiency in water) have been identified in recent years as one of the leading threats to the health of marine ecosystems. While this global problem has shown signs of improvement over the last ten years (source: World Resources Map), it remains a vast environmental challenge that mobilises policy-makers, the business community, farmers and NGOs around the world.

Eutrophication in coastal waters is the result of exponential growth of macro and micro algae enriched with nutrients. It can cause the loss of subaquatic vegetation, changes in species composition, damages to reefs and deterioration of water quality. At its most acute, it can cause hypoxia, the shortage of oxygen in water (due to biomass decomposition processes that consume oxygen contained in water), with damaging consequences for the surrounding aquatic life and biodiversity.

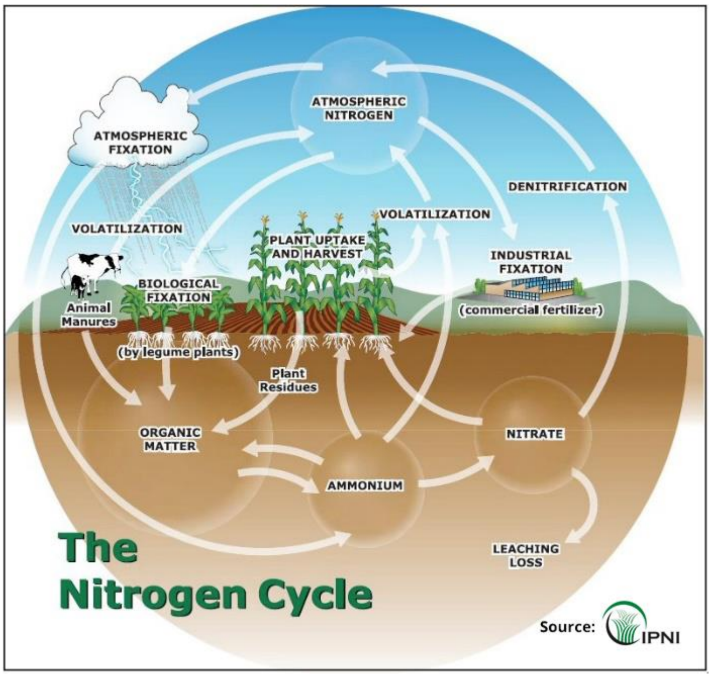
Eutrophication has been known to occur naturally, over long periods of time in water bodies that have grown filled with sediments (in areas with high soil erosion), or in some cases in water bodies close to naturally nutrient-rich soils. Climate change is another aggravating factor: as water temperatures rise, the conditions become more favourable for algae to take up plant nutrients and grow, especially in shallow or coastal waters.

B. Nutrient loss pathways

Eutrophication and hypoxia are caused by an over-abundance of N (Nitrogen) and P (Phosphorus) in water. These two nutrients are present in industrial and urban wastewater, as well as in organic fertilizers like manure, and mineral fertilizers.

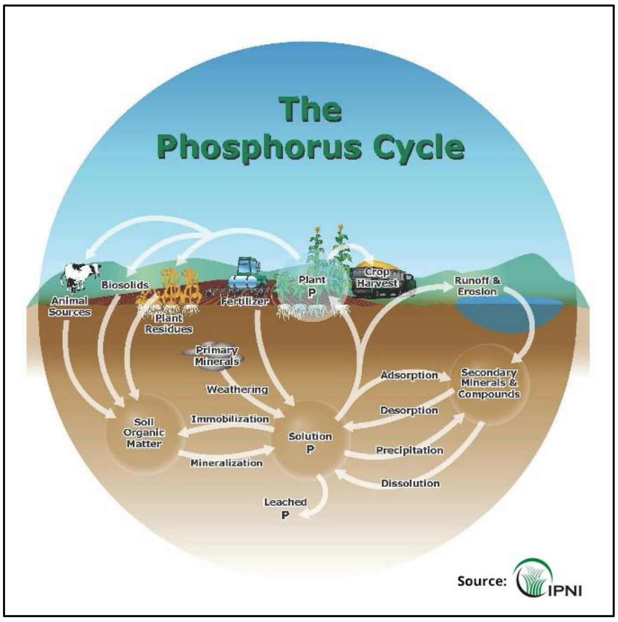
N and P cycles are complex, biological cycles and, by definition "leaky" systems, largely due to microbiological activity. N and P losses to the environment in various forms cannot be completely avoided.

During its trip in the cycle, nitrogen can be lost to the atmosphere through gaseous losses, or reach groundwater by leaching and surface waters by runoff and atmospheric deposition. Specific to N, an atom of N can cascade through different reactive forms (e.g. nitrate, ammonium, ammonia, nitrous oxide, organic matter) before returning back to the atmosphere as inert dinitrogen.



The P cycle is less complex, since P is not lost to the atmosphere. Most P losses to waterbodies occur through erosion of particulate matter and runoff.

Since soils are natural systems that are constantly subjected to changes due to the combined effects of the environment (i.e. rainfall, weathering, etc.), plant growth and management practices, it is impossible to totally eliminate P losses from soil. Water moving across the surface or through soils can remove both soluble (dissolved) and particulate (eroded soil particles) and increase the concentration of P in surface waters (i.e. streams, rivers, lakes and oceans).



N and P losses occur from **point-source pollution**, i.e. **pollution from a single identifiable source** such as industrial sites or wastewater treatment sites, and as such, are often the most visible (and therefore, measurable and abatable). Eutrophication and hypoxia are also caused by **non-point source pollution**, i.e. pollution from diffuse sources being carried to coastal waters through rainfall or snow melt. **Non-point source pollution is difficult to measure and more complex to abate than point-source pollution**.

With the growing awareness of the consequences of nutrient leakage, the fertilizer industry has taken a number of pro-active steps to enable an optimized use of plant nutrients and to mitigate unintended externalities on the environment.

Industry response

The fertilizer industry is cognizant of the role of fertilizers in nutrient losses to water and is actively engaged to reduce such losses by promoting nutrient stewardship.

Fertilizer Best Management Practices (FBMPs)

The fertilizer industry promotes and communicates extensively about an inclusive framework for applying FBMPs called the "**4R Nutrient Stewardship**". The 4Rs refer to the science-based application of the Right nutrient source, at the Right rate, at the Right time, in the Right place. They can be applied by every farmer, whether in a developed or developing country, empowering them to increase their yields, crop quality and income, while improving health of their soils and protecting the environment.

FBMPs are agricultural production techniques and practices developed through scientific research and verified and continuously adapted in the fields to improve nutrient management performance consistent with economic, social and environmental goals set by society.

Right Source
- Soil testing
- N, P, K, secondary and micronutrients
- Enhanced-efficiency fertilizers
- Nutrient management plans

Right Time
- Application timing
- Controlled-release technologies
- Inhibitors
- Fertilizer product choice

Right Place
- Application method
- Incorporation of fertilizer
- Buffer strips
- Conservation tillage
- Cover cropping

Right Rate
- Soil testing
- Yield goal analysis
- Crop removal balance
- Nutrient management planning
- Plant tissue analysis
- Applicator calibration
- Crop scouting
- Record keeping
- Variable rate technology
- Site-specific management

Optimization of agricultural practices

Furthermore, farmers can turn to agricultural practices that have been shown to contribute to preserve soil health and reduce nutrient losses to the environment:

- growing cover crops (i.e. planting of fast-growing plants between two crops in order to reduce soil erosion risk)
- continuous crop rotation
- reduced- or no-tillage practices or other conservation agriculture practices

- strip cropping (i.e. cultivating a field divided into long, narrow strips which are alternated in a crop rotation system)
- grass buffer strips along waterbodies.

Public Private Partnerships

The industry is an active partner in a number of multi-stakeholder, international research initiatives focused on reducing nutrient losses to the environment.

IFA is a partner of the "**Global Partnership on Nutrient Management" (GPNM)**, whose purpose is to steer dialogues and research reports and conducts pilot projects to improve implementation of effective nutrient management. IFA supports actively the project "**Towards an International Nitrogen Management System (INMS)**, a global targeted project running from 2016 to 2019 that seeks to integrate N in all international environmental policy dialogues.

As part of IFA's partnership with the Food and Agriculture Organization (FAO), IFA was also involved in the drafting of the **FAO's 2016 Voluntary Guidelines for Sustainable Soil Management**. While the primary focus of these guidelines is to increase soil fertility and increase soil organic matter, their positive externalities include the prevention of excess nutrients losses from agricultural fields through soil erosion and run-off. IFA also contributed to the development of the **UN Global Compact's Principles for Sustainable Soil Management**: https://www.unglobalcompact.org/docs/issues_doc / agriculture_and_food/soil-principles.pdf

Voluntary Commitments

Australia's Great Barrier Reef:

The decline of the Great Barrier Reef is attributed to three factors: tropical cyclones, coral predation by crown-of-thorns starfish (COTS), and coral bleaching. COTS seem to thrive in the coral reef thanks to the growth of phytoplankton, accelerated by a water rich in nutrients and sediments.

Actions:

Through IFA's affiliated member **Fertilizers Australia**, the Australian fertilizer industry has made a strong commitment to promoting productivity while protecting the environment through the national nutrient stewardship program Fertcare®. Fertcare® provides training on best agriculture management practices and an accredited advisor program, and assists farmers in addressing water quality issues from catchments.

Together with regional government authorities, Fertilizers Australia supports site-specific nutrient management programs, like the "*Six Easy Steps*" for sugarcane production in the north Queensland coast. Fertilizer Australia provides advice to the Queensland Government on proposed regulatory measures related to nutrient management through the "Agricultural Regulation Stakeholder Advisory Group".

The Australian fertilizer industry also engages in multi-stakeholder initiatives, like **Project Catalyst,** a partnership between more than 70 innovative Queensland cane growers and organisations like Reef Catchments, Canegrowers, the Australian Government, and WWF. The objective in the Great Barrier Reef catchments is to meet the 2050 Reef Plan target of a 50% reduction of dissolved N loads in priority areas.

Achievements:

Regulations and industry best management practices have had some success in reducing the presence of nutrients in water entering the Great Barrier Reef: In 2015, a Reef Report Card indicated an average annual nutrient load reduction of around 18% between 2009 and 2015.

The Gulf of Mexico

The Mississippi-Atchafalaya River basin is the largest contributor of freshwater of the Gulf of Mexico: (EPA Science Advisory Board, 2007)

IPNI: Map showing the extend of the Mississippi-Atchafalaya River basin

The basin covers 55% of the U.S agricultural lands, includes 33 major river systems and 207 estuaries (IPNI,1999). The Northern Gulf of Mexico is regularly affected by a hypoxic zone, manifesting itself usually beginning in the late spring and peaking in early summer. This eutrophic zone is mainly due to pollution in rivers of the basin, that discharge into the Gulf. Other natural phenomena, such as the change in weather patterns and precipitation within the basin, fresh water stratification over salt water, and loss of coastal wetlands, also contribute to the decline of the Gulf's coastal water quality.

Actions:

Through the **International Plant Nutrition Institute (IPNI),** the fertilizer industry monitors closely the N and P balances and trends of the Mississippi-Atchafalaya Basin, as well as the flux of N and P to the Gulf. A "Hypoxia Task Force" of the Mississippi Basin was created by several surrounding States and federal agencies. Twelve states adjacent to the Mississippi River have developed and are implementing Nutrient Loss Reduction Strategies. **Members of The Fertilizer Institute (TFI) and Fertilizer Canada (FC)** actively contribute to this effort through 4R Nutrient Stewardship education and outreach; as well as the *4R Research Fund*, which is designed to identify research-based nutrient management optimization to enhance sustainability and minimize environmental impact through the implementation of site-specific 4R nutrient stewardship, in concert with targeted soil and water conservation practices in the United States and Canada.

Moreover, the North American fertilizer industry makes sure the water it discharges is in compliance with the federal *National Pollutant Discharge Elimination System permits (NPDES)*. Most companies go beyond these regulatory requirements and conduct their own water sampling, analysing and treatment.

Finally, the fertilizer industry takes part in local multi-stakeholder initiatives, such as the Illinois Council for Best Management Practices and Illinois Fertilizer and Agrichemical Association, who have developed a soil sampling and nitrate-N testing network to monitor and assess the need for N and risks for loss of nitrate-N in subsurface drainage and runoff water. Other efforts include the Iowa "4R Plus initiative" (fertilizer BMPs plus mitigating conservation practices) and the Iowa Nutrient Research and Education Council.

Additionally, a program started in the Western Lake Erie Basin, but which has expanded to all of Ohio, established a 4R Certification program for fertilizer retailers and agronomy service providers. Participants are certified based on employee and farmer education and audits reviewing 4R practice recommendations and farmer implementation.

Achievements:

Recent work is showing some positive trends, especially in the Illinois River sub-basin. There, the river flow-weighted nitrate concentrations have been declining since 2010, while fertilizer N consumption has slightly increased. Illinois is one of the leading corn and soybean producing states in the U.S.