



Demand and supply by Erik Johansson

MITIGATING MARINE EUTROPHICATION IN THE PRESENCE OF STRONG SOCIETAL DRIVING FORCES

SWEDISH INSTITUTE FOR THE MARINE ENVIRONMENT

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ABOUT THE REPORT

This report, which was commissioned and financed by the Swedish Agency for Marine and Water Management (SwAM), is devoted to current and potential future measures to mitigate the eutrophication of marine waters. It is meant to be used as a background report for Swedish actors at the high-level UN Ocean Conference that will convene at the UN Headquarters in New York in June 2017. This Conference aims to support the implementation of Sustainable Development Goal 14: 'Conserve and sustainably use the oceans, seas and marine resources for sustainable development' and is intended to be the game changer that will reverse the decline in the health of our oceans for the benefit of people, the planet, and prosperity.

This report also aims to serve as a motivator for further actions against marine eutrophication in both Sweden and in other countries, and it brings together both old and new perspectives on measures that can prevent and reduce marine eutrophication. A review of current measures in selected countries is complemented by a presentation of potential new measures that can expand the range of intervention options. Special attention is paid to transformative measures that involve new groups of actors and that take into account relevant societal trends. A set of recommendations for decision-makers in governments, agencies, and commercial enterprises concludes the report.

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EXECUTIVE SUMMARY

Man-made eutrophication of lakes, coastal waters, and oceans occurs in practically all populated parts of the world, and in many regions the problem is increasing. The ecological effects of excessive input of nutrients include massive algal blooms, extensive oxygen depletion, and recurrent incidences of fish kills. The East China Sea, the Gulf of Mexico, the Bay of Bengal, and the Baltic Sea are some examples of sea basins in which nutrient over-enrichment has resulted in unnaturally large hypoxic zones, where the oxygen concentration is so low that animal life suffocates and dies. Such serious effects are negative not only for ecological reasons, but they also mean the loss of economically valuable resources.

Measures to prevent or reduce fluxes of nutrients into marine waters were first undertaken in some parts of Europe and North America. Wastewater treatment plants in urban areas were upgraded to enable the efficient removal of nutrients, and discharges from industry were substantially reduced. Step by step, diffuse emissions from agriculture, transport, and other sectors were also addressed. A brief review of the measures currently in place in a number of countries showed that, despite progress in some areas, the targets of international conventions and other agreements are rarely completely achieved. One reason might be that the flow of nutrients through society and into coastal waters is strongly intertwined with basic human needs, especially the production and consumption of food. Another reason might be that all relevant actors do not participate in the mitigation efforts. In addition, the impact of global social and economic trends is rarely addressed by the authorities who are developing programs of measures (POMs).

This report elucidates how politicians, numerous decision-makers in both authorities and enterprises, and conscious consumers can help to reduce eutrophication of coastal waters and oceans. This is done by first reviewing the current measures and instruments in place to mitigate marine eutrophication. Thereafter, it is explored how the range of intervention options can be expanded by systematically linking the flows of substances and goods to the relevant actors and by assessing these actors' potential to influence nutrient fluxes. Selected global trends and innovative technologies of relevance are also considered. Moreover, the need and benefit of simultaneously working toward different sustainable development goals is addressed.

Current measures in selected countries.

Sweden, which is one of the nine Baltic Sea countries, has developed a very complex mix of physical measures and policy instruments to combat marine eutrophication. Efficient wastewater treatment has been accomplished by simultaneously paying attention to institutions, legislation, and financing of measures. Leakage of nutrients from agriculture has been reduced by combining legislation and ordinances from the Government and national agencies with inspections and guidance from county administrative boards and municipalities. Voluntary actions by farmers are to some extent subsidized. Emissions from shipping, especially nitrogen emissions from fuel combustion, are another major source of marine eutrophication, and national regulations have been decided upon and implemented. Collaboration with other countries is needed to achieve unified actions, but such actions take time.

Denmark, which is another Baltic Sea nation, produces large amounts of pig meat, and this has made it necessary to address the leakage of nutrients from agriculture. Originally, nitrate pollution of inland waters and groundwater was in focus, but measures to protect such waters have also resulted in the improved status of marine waters. Politically, Denmark has met the challenges by employing two different abatement strategies. Detailed regulation of agricultural practices using almost identical rules in the whole of Denmark is now being replaced by spatially differentiated regulation.

The Netherlands by the North Sea is another country with large-scale and intensive animal farming. Because livestock production generates considerably more manure than is required by agriculture in the immediate vicinity, the cycling of nutrients is disrupted. To reduce regional imbalances in nutrient fluxes, Dutch farmers are now required to have a certain percentage of their surplus manure treated for sale outside the Dutch fertilizer market.

In the US, POMs have long had a strong focus on point-source emissions, including emissions from concentrated animal feeding operations. Extensive outreach activities, voluntary actions, and strong ambitions to involve a wide range of stakeholders characterize several of the POMs. However, the overall progress to reduce fundamental imbalances in nutrient fluxes in food production has been slow.

India and Bangladesh, which border the Bay of Bengal, are two countries with a rapidly increasing population and rapid urbanization. Urban sanitation and wastewater treatment for the large cities are in focus, but without upgrading the treatment systems so that they include efficient removal of nutrients, there is a substantial risk of increased eutrophication problems.

China has changed faster than any other large country over the past few decades. New environmental laws and substantial investments in wastewater treatment plants indicate an increased willingness to address water pollution, including marine eutrophication. However, implementation of new environmental standards is lagging behind changes in nutrient fluxes. The impact of urbanization, transitions in agriculture, and dietary shifts are so strong that fundamental imbalances in nutrient fluxes are likely to persist for a long time.

Generally, abatement of eutrophication problems starts with efforts to eliminate hot spots of nutrient pollution by regulating point-source emissions and agricultural practices. Addressing eutrophication by considering large-scale imbalances in nutrient fluxes and desirable transitions in society usually comes later. Increased cooperation within sea conventions, stronger involvement of major enterprises, and coordinated efforts to simultaneously achieve several sustainable development goals represent a way forward.

Cooperation within international sea conventions and watershed task forces

In Europe, the contracting partners of the HELCOM and OSPAR conventions are cooperating to reduce eutrophication in the Baltic Sea and the Northeast Atlantic, respectively. Such regional sea conventions are important platforms for mutual decisions between the member states. They also form bodies large enough to push forward issues in global organizations such as the International Maritime Organization. The European Union broadens the cooperation possibilities by offering more partners and by providing unified legislation and financial support.

India and Bangladesh participated in the Bay of Bengal Large Marine Ecosystem project as a way to share visions and objectives and to engage in discussion concerning the measures to be implemented. This project ended in 2015, and future work related to the project is currently being discussed.

In the US and China, the Mississippi and Yangtze river basins are so large that watershed task forces play a key role in abatement programs.

Expansion of intervention options

The human pressure on many coastal and offshore water bodies remains unacceptably high even though several measures have already been implemented. This indicates that there is a need to expand the range of intervention options. Systems analysis of fluxes of nutrients through society can reveal a multitude of activities and behavioral patterns of institutions, organizations, and individuals that affect the pressure on marine environments.

When developing policy instruments and measures to reduce the pressure on marine environments, it is important to identify actors who have the potential to change their behaviors. By analyzing product chains, it is often possible to identify such actors or groups of actors. A case study of the product chain for meat produced and consumed in Sweden revealed that although the number of activities in the chain is large, the actual number of influential actors is rather small. This study also showed that it is not only the actors who actually release nutrients into the sea who can influence the nutrient loads. Large food retailers, for example, can influence what is consumed and thereby also the fluxes of nutrients along the entire chain from production of animal feed and food to emissions from sewage systems. Chefs with a media presence, NGOs, and conscious consumers are other examples of key actors.

Taking stock of the current measures as well as our general procedure for linking key actors to fluxes of substances and products, we propose new measures to mitigate the eutrophication of marine waters. In contrast to many of the current measures that can be characterized as end-of-pipe solutions or cleanup operations, these new measures have the potential to transform society into becoming more ecologically, economically, and socially sustainable. The proposed measures all relate to dietary issues or to better recycling of nutrients.

Three proposed measures

A. Protein consumption adjusted to health requirements.

People in many countries have increased their average protein consumption to levels far higher than needed. Phosphorus and nitrogen fluxes through society and from society to nature increase with increased protein consumption. Taking Sweden as an example, a 20% lower production and consumption of protein could substantially lower the nutrient input into the Baltic Sea without increasing the risk of protein deficiency. Such dietary changes are in the hands of many actors such as legislators, agencies, market actors, and NGOs.

B. Increased aquaculture with minimal loss of nutrients.

Aquaculture has considerable potential to efficiently produce high-quality protein. Fish farming in land-based recirculating systems allows almost full control of nutrient fluxes. Using feed that is not based on marine animals, the pressure on the marine environment

is also minimized in other respects. Market actors and entrepreneurs can support this development, but government involvement is needed for guidance, monitoring, and regulation. In addition, consumers need guidance and motivation to change their eating habits.

C. Recovery of phosphorus from sewage sludge.

Wastewater treatment plants produce increasing amounts of sludge that contains valuable nutrients, especially phosphorus. However, due to undesirable pollutants, the use of sludge for direct application on arable land is limited in many countries. Due to the worldwide urbanization trend, there is also an increasing need to recirculate nutrients from cities to arable land. With new technologies, and at reasonable cost, phosphorus can be recovered from sludge as a clean product that can be traded. Politicians can contribute to this development by creating proper legislation and by stimulating cities to become models for nutrient recycling.

Ten recommendations

The report contains a set of recommendations that can help to achieve the UN sustainable development goal about life below water (SDG 14) by pushing forward transformative changes in society.

First, promote activities that raise awareness of the root causes of eutrophication! The awareness of how societal trends and the behavior of numerous actors in society contribute to pressure on marine environments is insufficient. National agencies and actors in the food sector can:

1. Establish recognized platforms where professional actors from national agencies, local authorities, and the food sector are invited to identify their own role and their own responsibility for reducing eutrophication.
2. Develop tools and platforms that can facilitate collaboration between actors in different parts of a product chain with a common goal to reduce marine eutrophication.

Moreover, engage commercial actors to promote sustainable diets! Many consumers have an overconsumption of protein, especially red meat. Governments, national agencies, and commercial actors in the food sector can:

3. Take actions to make it easier for consumers to adjust their total intake of protein to levels motivated by health reasons.

Support new concepts for more efficient recycling of plants nutrients! Urbanization and industrialization of agriculture have created fundamental regional imbalances in the fluxes of nitrogen and phosphorus. Governments can:

4. Implement mandatory processing and recycling of surplus manure in regions with intensive animal farming and support innovations in the processing of manure into valuable, transportable products.
5. Introduce mandatory recovery of depolluted phosphorus from sewage sludge and develop an internationally harmonized quality control framework for recycling of phosphorus into agricultural soils.

Support sustainable forms of aquaculture! Fish farming in land-based recirculating systems along with limited use of animal feed can offer more sustainable nutrient fluxes. Non-fed aquacultures of mollusks and seaweeds are underexploited sources of food in large parts of the world. Governments and politicians can:

6. Support the development of environmentally sound systems for fish production in land-based closed containments and establish or support a certification system for such production.
7. Promote expansion of markets for mollusks and seaweeds from non-fed aquacultures.

Establish strong institutions with a mandate to undertake coordinated actions! Governments can:

8. Use regional sea conventions and watershed programs to promote cleanup operations as well as transformative measures regarding food production and consumption.
9. Give national authorities the mandate to handle goal conflicts so that mitigation of marine eutrophication is accomplished without sacrificing food security or other sustainable development goals.

Finally, capitalize on environmental synergies! Governments and national agencies can:

10. Make efficient use of climate actions that also mitigate eutrophication effects.



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