

## Combating marine eutrophication – could transformative, up-stream measures be one way forward?

Anthropogenic eutrophication of lakes, coastal waters, and oceans occurs in practically all populated parts of the world, and the problem is increasing in many regions. 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. 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 not all relevant actors 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).

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. However, the human pressure on many coastal and offshore water bodies remains unacceptably high even when several measures have been implemented. This indicates that there could be a need to expand the range of intervention options.

### [In a new report SIME suggests a set of up-stream, transformative measures](#)

A recent report, commissioned by the Swedish Agency for Marine and Water Management (SwAM) from the Swedish Institute for the Marine Environment (SIME) presents a brief review of the measures currently in place to combat eutrophication in selected countries across the world: Sweden, Denmark, The Netherlands, the US, India, Bangladesh and China. In the report, a set of up-stream transformative measures is suggested that can expand the range of intervention options. The measures involve new groups of actors and that take into account relevant societal trends. Furthermore a set of recommendations is presented that could be considered by decision-makers in governments, agencies, and commercial enterprises. Some conclusions in the study are that systems analysis of fluxes of nutrients through society can reveal a multitude of activities and behavioral patterns of institutions, organisations, and individuals that affect the pressure on marine environments.

The authors also suggest that increased cooperation within sea conventions, stronger involvement of major enterprises, and coordinated efforts, to achieve several sustainable development goals simultaneously, could represent one way forward. The main conclusion is that politicians, numerous decision-makers in both authorities and enterprises, and conscious consumers can help to reduce eutrophication of coastal waters and oceans.

#### 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 organisations such as the International Maritime Organisation. The European Union broadens the cooperation possibilities by offering more partners and by providing unified legislation and financial support.

#### Expansion of intervention options

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 analysing product chains, it is often possible to identify such actors or groups of actors. The study showed that more actors than those who release nutrients into the sea could influence the nutrient loads. Large food retailers, for example, can influence what is consumed. Thereby they can also influence 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 a general procedure for linking key actors to fluxes of substances and products, new measures are suggested to mitigate the eutrophication of marine waters. In contrast to some of the current measures that can be characterised as end of pipe solutions, the proposed measures have the potential to transform society into becoming more ecologically, economically, and socially sustainable.

#### Suggested measures concerning dietary issues and recycling of nutrients

In the study, SIME proposes three measures that relate to dietary issues or to better recycling of nutrients:

- 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, including the sea increase with increased protein consumption.
- B. **Inland-based aquaculture with recirculating systems.** Aquaculture has considerable potential to produce high-quality protein efficiently. Fish farming in land-based recirculating systems allows almost full control of nutrient fluxes and therefore a minimal loss of nutrients. If feed that is not based on marine animals is used, the pressure on the marine environment is also minimised in other respects. Market actors and entrepreneurs could support this development, but there is a need for government involvement 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 urbanisation trend, there is also an increasing need to recirculate nutrients from cities to arable land. With new technologies, and at reasonable cost, phosphorus could be recovered from sludge and become a clean, tradable product. Politicians can contribute to this development by creating proper legislation and by stimulating cities to become models for nutrient recycling.

#### Up-stream, transformative recommendations

In the report, SIME suggests 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. The suggested actions in the report concerns:

##### *Promotion of 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 could engage themselves by establishing recognised platforms where professional actors from national agencies, local authorities, and the food sector is invited to identify their own role and their own responsibility for reducing eutrophication. They could also develop tools and platforms to facilitate collaboration between actors in different parts of a product chain with a common goal to reduce marine eutrophication.

##### *Engagement of commercial actors to promote sustainable diets*

In some countries, many consumers have an overconsumption of protein, especially through eating red meat. In these countries Governments, national agencies, and commercial actors in the food sector could engage themselves in actions to make it easier for consumers to adjust their total intake of protein to levels motivated by health reasons.

##### *Support of concepts for more efficient recycling of plants nutrients*

Urbanisation and industrialisation of agriculture have created fundamental regional imbalances in the fluxes of nitrogen and phosphorus. Governments could engage themselves in actions to implement and regulate processing and recycling of surplus manure in regions with intensive animal farming and support innovations in the processing of manure into valuable, transportable products. They could also engage themselves in introduction of recovery of depolluted phosphorus from sewage sludge and develop an internationally harmonised quality control framework for recycling of phosphorus into agricultural soils.

##### *Support of 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 could engage themselves in support of the development of environmentally sound systems for fish production in land based, closed containments and establish or support a certification system for such production. They could also engage themselves in promotion of expansion of markets for mollusks and seaweeds from non-fed aquacultures.

*Establishment of strong institutions with a mandate to undertake coordinated actions*

Governments could engage themselves in the use of regional sea conventions and watershed programs to promote clean-up operations as well as transformative measures regarding food production and consumption. They could also give authorities mandate and responsibility to handle goal conflicts so that mitigation of marine eutrophication is accomplished without sacrificing food security or other sustainable development goals.

*Capitalisation of on environmental synergies*

Governments and national agencies could engage themselves in making efficient use of climate actions that also mitigate eutrophication effects.

This text is based upon the following report made by Swedish Institute for the Marine Environment (SIME): Mitigating marine eutrophication in the presence of strong societal driving forces, Report no. 2017:3. Authors: Anders Grimvall, Eva-Lotta Sundblad and Lars Sonesten.

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The report is published here: [www.havochvatten.se/en/initiativesforsdg14](http://www.havochvatten.se/en/initiativesforsdg14)