

# Eutrophication

## Innholdsfortegnelse

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Despite all that has been done over the past 20–30 years to reduce nutrient releases, inputs have risen, especially from fish farming. We should therefore assess whether further action is needed. Climate change will increase runoff from land, making it even more important to consider new measures.



The nutrient load is higher in the Skagerrak than anywhere else along the coast of Norway. This photo shows mats of green algae, which are typical of coastal areas where eutrophication is a problem. Photo: Climate and Pollution Agency



Excess nutrients can result in sediment deposition, smothering life on the seabed. Photo: Climate and Pollution Agency

STATE

## Eutrophication still a serious concern

Eutrophication in coastal waters and fjords in Norway is caused by discharges of nutrients from fish farming, runoff from agricultural areas, and inputs from industry and municipal waste water treatment. In addition, there is long-range transport of nutrients with ocean currents from more southerly parts of Europe. The latter process has particularly marked effects along the Skagerrak coast, but also influences the coastal waters of Western Norway.

High concentrations of nutrients have a greater impact in fjords than in open coastal waters. Many Norwegian fjords have a sill near the entrance where the water is shallow. This restricts water exchange, so that turnover of the bottom water is very slow and excess nutrients readily cause eutrophication. Oxygen depletion and sediment deposition are the most serious effects.

### Climate change may exacerbate the problems

Inputs of nutrients to coastal waters are expected to rise with climate change, which will entail higher erosion rates and more leaching of nutrients from soil, because:

- precipitation is expected to rise, especially in winter;
- winter temperatures are expected to fluctuate more, and this may result in repeated freezing and thawing of agricultural areas.

Both of these factors are likely to increase the amounts of nutrients leached from soils and transported to coastal waters.

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#### IMPACT

## Algal blooms and oxygen depletion

Adequate nutrient supplies are needed for ecosystems to function properly. But if inputs are too high, excess nutrients may accumulate, with negative ecological impacts.

The effects include blooms of planktonic algae, accelerated growth of macroalgae, sediment deposition that smothers benthic organisms and reduced light penetration. Rising quantities of decaying biological material can result in oxygen depletion. In the longer term, the result may be a reduction in biodiversity and more frequent blooms of toxic algae.

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#### DRIVING FORCES

## Larger quantities of nutrients in circulation

During the past 50–100 years, growing quantities of nutrients have come into circulation as a result of far-reaching changes in social structures and strong economic growth.

Agricultural production has become much more intensive, and far larger quantities of mineral fertilisers are used. Emissions of nitrous gases to the atmosphere have risen with the growing volumes of transport and industrial production. This results in nitrogen deposition in water bodies with precipitation and particulate matter.

The fish farming industry has expanded greatly in the past 20 years, and there has been an accompanying steep rise in discharges of nutrients. Fish farming is now the largest source of anthropogenic releases of nutrients in Norway.

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#### PRESSURE

## Fish farming, agriculture and waste water

Norwegian coastal waters can be divided into four main areas: the Skagerrak, the North Sea, the Norwegian Sea and the Barents Sea, with different levels of nutrient inputs.

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## Fish farming the largest Norwegian source of nutrients

Fish farming is the largest source of nutrient inputs to the North Sea, the Norwegian Sea and the Barents Sea. Discharges are highest in the Norwegian Sea: fish farms in this area account for almost half of Norway's total phosphorus releases. The absolute rise in inputs has also been highest in the Norwegian Sea: phosphorus inputs have tripled since 1998.

The situation in the Skagerrak is different: here, agriculture and municipal waste water are the largest sources of nutrient inputs. The most densely populated areas of Norway drain into the Skagerrak, which explains the relatively high inputs from municipal waste water. Inputs of nutrients to the Skagerrak coast from Norwegian sources have been fairly stable ever since 1990.

## Inputs of nutrients from soil and the atmosphere

Inputs of nutrients via precipitation and natural processes in soils and bedrock are known as background inputs, and make an important contribution to total nutrient loads.

Inputs via the atmosphere were previously included in background inputs, but it is now recognised that a substantial proportion of the nutrients deposited, especially nitrogen, originates from human activities and long-range transport of pollutants.

## Inputs of nutrients with ocean currents

Transport of nutrients with ocean currents is a natural process, but excess concentrations of nutrients in the water can result in eutrophication. Monitoring shows that Norwegian coastal waters, especially along the Skagerrak coast, are influenced by nutrients transported from other European countries.

The map shows ocean currents along the Norwegian coastline. You can zoom to investigate further.

## RESPONSE

## Much has been done, new action being considered

Over the past 20–30 years, Norway has done a great deal to reduce discharges of nutrients from agriculture, municipal waste water treatment and industry. Similar steps have been taken in much of the rest of Europe, and these also benefit Norway.

Despite this, current discharge levels are still so high that they are affecting water quality, and further action needs to be considered. Norway is drawing up proposals for stricter regulation of the fish farming industry, including requirements for more thorough environmental surveys.

Nutrients are also transported to Norway from more southerly parts of Europe with ocean currents. This makes it particularly important for Norway to be involved in international efforts to highlight these problems and identify what needs to be done. Important agreements and channels for cooperation include the EU, OSPAR, UNCLOS, MARPOL, the Ballast Water Convention and the Convention on Biological Diversity.

## Other action that should be considered

- Further steps to reduce inputs to the Skagerrak coast, parts of Vest-Agder and Rogaland counties and other areas where eutrophication is occurring or that are at risk of eutrophication. Possible measures include introducing stricter treatment requirements under the Pollution Control Act and in individual discharge permits, and incorporating such requirements during work on river basin management plans.
- Obtaining more knowledge about areas where nutrient discharges are rising but too little is known about the state of the environment. One possibility is to introduce requirements under the Pollution Control Act for companies that discharge large quantities of nutrients to investigate pollution levels in nearby areas.

