4. Eutrophication and organic pollution of water

4.1 Storyline for indicators

The overloading of seas, coastal waters, lakes and rivers with nutrients (nitrogen and phosphorus) can result in a series of adverse effects known as eutrophication. In severe cases of eutrophication, massive blooms of planktonic algae occur. Some blooms are toxic. As dead algae decompose, the oxygen in the water is used up; bottom-dwelling animals die and fish either die or leave the affected area. Increased nutrient concentrations can also lead to changes in the aquatic vegetation. The unbalanced ecosystem and changed chemical composition make the water body unsuitable for recreational and other uses such as fish farming, and the water becomes unacceptable for human consumption. The main source of nitrogen pollution is run-off from agricultural land, whereas most phosphorus pollution comes from households and industry.

The effects on the aquatic environment of organic pollution, caused by discharges from wastewater treatment plants, sewage sludge disposal to coastal waters (in the Mediterranean Sea) industrial effluents and agricultural runoff, include reduced river water chemical and biological quality, as well as impaired biodiversity of aquatic communities and microbiological water quality. Increased industrial and agricultural production, coupled with more of the population being connected to sewerage, has resulted in increases in discharges of organic waste and nutrients into surface water in most European countries since the 1940s. Over the past 15 to 30 years, however, biological treatment of wastewater has increased, and organic discharges have consequently decreased across most of Europe.

The main policy objectives are:

- *To prevent further deterioration and protect and enhance the status of aquatic ecosystems and to ensure the progressive reduction of pollution of groundwater and prevent its further pollution.*[1]
- *To achieve levels of water quality that does not give rise to unacceptable risks to, human health (and the environment)*[2]*. Drinking water must be free of any microorganism, parasite or substance that could potentially endanger human health and nitrate levels must be less than the standards (guide level 25 mg NO_3/l, maximum allowable concentration 50 mg NO_3/l). In addition bathing water must achieve levels of microbiological contamination that do not give rise to significant impacts on or risks to human health.*[3]
- *A progressive reduction of anthropogenic inputs of organic matter and nutrients into the water environment where these inputs are likely to cause such eutrophication and depleted oxygen problems*[4]*.*

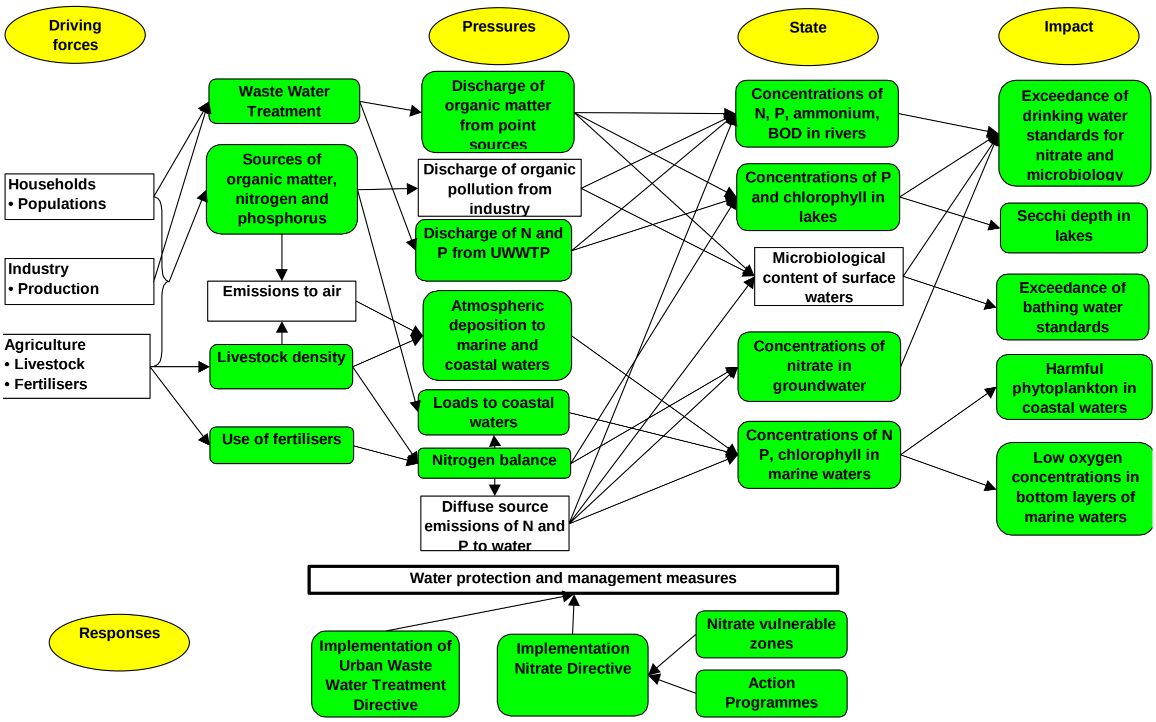
Proper and full implementation of the Urban Waste Water Treatment Directive and of the Nitrates Directive will be an important positive factor in reducing eutrophication[5]. Member States shall implement the necessary measures to prevent deterioration of the status of all bodies of surface water and implement the measures necessary to prevent or limit the input of pollutants into groundwater.[6]

[1] Water Framework Directive Article 4
[2] 6th Environmental Action Programme 5.2. Overall Environment-Health Objective & Drinking Water Directive (80/778/EEC and it's revision 98/83/EC)
[3] Bathing Water Directive (76/160/EEC)
[4] Partly based on coming Marine Strategy (COM(2002 539 final)
[5] 6th Environmental Action Programme 4. Nature and biodiversity – Protection of a unique resource - Marine environment (p. 35-36) & 5.6 Ensuring the Sustainable Use and High Quality of Our Water Resources (p.45-46)
[6] Water Framework Directive Article 4

4.2 Indicators used

The DPSIR framework for assessing eutrophication and pollution from organic matter is shown in Figure 4.1. The rectangles in green are those indicators used in this report.

Figure 4.1 DPSIR framework for assessing eutrophication and pollution from organic matter



Indicators used in this chapter and for which there are factsheets on the EEA's webpage (URL to be added).

There are a number of policies relevant to these indicators:

- Bathing Water Directive (76/160/EEC) aims to protect the environment and public health by reducing the pollution of bathing waters.
- Nitrates Directive (91/676/EEC) aims to reduce water pollution caused by nitrates by reducing the nitrogen input to agricultural land.
- Urban Waste Water Treatment Directive (91/271/EEC) establishes levels of treatment according to the size of population served by the treatment works and the sensitivity of the waters receiving the treated effluent. This Directive will lead to a reduction in nutrient and organic matter discharges from point sources.
- Integrated Pollution Prevention and Control Directive (96/61/EC) aims to control and prevent pollution to water by reducing or eliminating emissions from industry.
- Drinking Water Directive (98/83/EC) aims to ensure that water intended for human consumption is safe. Water intended for human consumption must be free of any micro-organisms, parasite or substance that could potentially endanger human health.
- Water Framework Directive (2000/60/EC) requires the achievement of good ecological status and good ecological potential of water bodies across the EU by 2015.

Table 4.1 summarises the assessments that are made in terms of the policy questions using relevant indicators. More detailed information and assessments then follow in the subsequent pages and indicator factsheets. An '✖' in the assessment column indicates that there is at this point no indicator developed or formulated to answer the specific policy question.

Table 4.1 Overall assessment of progress in meeting policy objectives in terms of eutrophication and organic pollution

Policy question	Indicators	Assessment
Question 1 Are nutrient and organic pollution decreasing?		
• Are we reducing the impact of nitrate on our groundwaters?	*Nitrate in groundwater*	☹ There is no evidence of a decrease (or increase) in levels of nitrate in Europe's groundwaters though nitrate drinking water limit values are exceeded in around one-third of the ground water bodies for which information is currently available.
• Are indicators of pollution with organic substances such as oxygen concentration, BOD and ammonium showing a positive trend?	*Organic matter in rivers*	☺ The organic pollution of rivers has markedly decreased in the 1990's.
• Are nutrients concentrations in our surface waters decreasing?	*Nutrients in rivers*	☺ Concentrations of phosphate have decreased in the rivers of the EU and Accession countries during the 1990's reflecting the general improvement in wastewater treatment over this period. ☹ Nitrate concentrations in most EEA rivers are still above natural levels with concentrations being particularly elevated in those Western European countries where agriculture is the most intensive.
	Phosphorus in lakes	☺ Eutrophication of European lakes is decreasing. ☹ However, there are still many lakes and reservoirs with high concentrations of phosphorus due to human activities. ☹ Phosphorus concentrations are highest in lakes in the Accession countries and lowest in the Northern countries.
	Nutrients in coastal and marine waters	☹ Nutrient concentrations in Europe's Seas have generally remained stable over recent years, though a few stations in the Baltic, Black and North (phosphate only) Seas have demonstrated a slight decrease in nitrate and phosphate concentrations. Fewer stations in the Baltic and North Seas also showed an increase in phosphate concentrations

Question 2 Are discharges of nutrients and organic matter from socio-economic sectors decreasing?		
• In which sector are discharges of organic substances and nutrients increasing/decreasing?	*Discharges of organic matter from point sources*	☺ Over the past 15 to 30 years biological treatment of wastewater has increased and organic discharges have consequently decreased across most of Western Europe. ☺ There have been marked reductions in the discharge of organic matter in the Accession countries during the 1990s, and in the five countries for which data are available, organic matter from point sources declined by more than 75 % from 1992 to 2000.
	Loads of nutrients discharged to sea	☺ Loads of both phosphorus and nitrogen from all quantified sources to the North Sea and Baltic Sea have decreased since the 1980's.
	Atmospheric deposition of nitrogen to marine and coastal waters	☹ The total quantity of nitrogen deposited into the North Sea from the atmosphere has remained relatively stable throughout the 1990's. ☺ Nitrogen depositions to the Baltic Sea have declined in the 1990's.
• Are discharges from urban wastewater treatment plants (households and small industries) being reduced?	*Development of Urban Waste Water Treatment*	☺ In several countries in north-western Europe there has in the 1990s been a marked increase in the population connected to tertiary wastewater treatment resulting in marked reductions in phosphorus and nitrogen emissions. ☺ Wastewater treatment in all parts of Europe has improved significantly since the 1970's. ☹ However the percentage of population connected to wastewater treatment is relatively low in southern Europe and in the Accession countries.
• Is water pollution caused or induced by nitrates from agricultural sources being reduced?	*Use of fertilisers*	☺ Phosphate fertiliser consumption has been decreasing in both the EU and Accession countries since the 1980's. ☹ Nitrogen fertiliser consumption increased until the late 1980s and then started to decline but in recent years it has increased again in the EU and EFTA countries. ☹ Phosphate and nitrogen fertiliser consumption per hectare of arable land is higher in the EU and EFTA countries than in the Accession countries. Mineral fertilisers are still a very important source of nutrient pollution.
	Numbers of livestock	☹ Livestock density is high in Western Europe. In combination with the high percentage of agricultural land in these countries, there is a high potential for nitrogen and phosphorus pollution.
	Nitrogen balance in agricultural soils	☹ There is a large nitrogen surplus in the agricultural soils of EU countries that can potentially pollute both surface and groundwaters.
• Are the discharges from industry being reduced?	*Emissions of organic matter and nutrients from industry*	✖

Question 3 Are we enhancing the status of the aquatic ecosystems and lowering the adverse effects of organic pollution and eutrophication?		
• Is water intended for human consumption (drinking water) wholesome and clean (free of microbiological contamination and nitrate levels less than 25 mg NO_3/l)?	*Microbiological contamination of drinking water*	☹ There are still problems with microbiological contamination of drinking water, particularly in the Accession countries
	Nitrate in drinking water	☹ Nitrate in drinking water is a common problem across Europe particularly from small supplies/wells in contaminated shallow groundwater
• Is bathing water quality improving?	*Bathing water quality*	☺ The quality of designated bathing waters (coastal and inland) has improved in Europe throughout the 1990's. ☹ Despite this improvement, 10 % of Europe's coastal and 28 % of inland bathing waters still do not meet (non-mandatory) guide values.
• Is the state regarding eutrophication of Europe's lakes, rivers and seas improving?	*Water transparency in lakes*	☺ The quality of water in terms of transparency has improved in European lakes since 1980 because of a reduction in concentrations of phosphorus resulting from measures to reduce discharges of phosphorus from point and other sources.
	Indicators of the biological quality elements for lakes under the WFD	✖
	Chlorophyll in coastal and marine waters	😐 Generally no trend is observed in summer surface chlorophyll-a concentrations in the Baltic Sea, Greater North Sea or Greek coastal waters.
	Harmful phytoplankton in coastal waters	☹ Since the 70's, the harmful algae phenomenon has increased throughout the world. There is no clear trend in shellfish poisoning events in European waters..
	Trophic Index (TRIX) for the Mediterranean sea and other sea regions	✖
	Macrophytes in coastal waters	✖
• Is the state regarding eutrophication of Europe's lakes, rivers and seas improving?	*Low oxygen concentrations in bottom layers of marine waters*	😐 Generally no trend is observed in the frequency of low oxygen concentrations in the Baltic Sea, North Sea and Mediterranean Sea. ☹ Low oxygen concentrations are a problem in specific estuaries with large inputs of nutrients and little mixing of the water column as well as in stratified coastal waters and in the deep troughs of the Baltic Sea and entire Black Sea.
	Biological and physico-chemical classification of transitional and coastal zones less than 'good' quality in national classifications	✖
• Are some areas of Europe facing negative trends regarding organic pollution or eutrophication?		✖
• Is the number of locations with less than good ecological status due to organic pollution and eutrophication decreasing?		✖

Question 4 How effective are existing policies in reducing loading of nutrients and organic matter?		
• Is the Urban Waste Water Treatment Directive being implemented in Member States?	*Implementation of the Urban Waste Water Treatment Directive*	☹ In 1998, only two EU countries were close to conforming to the requirement of the Directive for their large agglomerations discharging into sensitive areas, and eight countries were far from conformity. ☹ Many large cities did not have a sufficient standard of treatment to meet the objectives of the Directive.
• Is the Nitrates Directive being implemented in Member States?	*Implementation of the Nitrates Directive*	☺ Considerable progress has been made in most Member States in developing action programmes for nitrate vulnerable zones. ☹ However, none of the action plans fully comply with the obligations that are specified in the 'Nitrates Directive'.

✖ Indicator to be developed

Policy Question 1: *Are nutrient and organic matter pollution decreasing?*

Nitrate in groundwater

Agriculture is the largest contributor of nitrogen pollution to groundwater. Nitrogen from excess fertiliser percolates through the soil and is detectable as elevated nitrate levels under aerobic conditions and as elevated ammonium levels under anaerobic conditions. The rate of percolation is often slow and excess nitrogen levels may be the effects of pollution on the surface up to 40 years ago depending on the hydrogeological conditions.

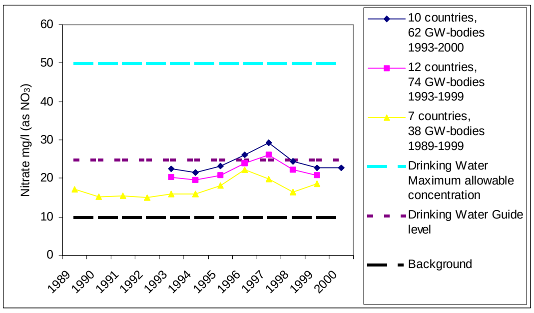
The Nitrates Directive (91/676/EEC) aims to control nitrogen pollution and requires Member States to identify groundwaters that contain more than 50 mg/l nitrate or could contain more than 50 mg/l nitrate if preventative measures are not taken. In addition, the Drinking Water Directive (98/83/EC) sets a quality standard for nitrate of 50 mg/l. It has been shown that drinking water in excess of the nitrate limit can result in adverse health effects, especially in infants less than 2 months of age. Groundwater is a very important source of drinking water in many countries and it is often used untreated particularly from private wells.

Mean nitrate levels in groundwaters in Europe are above background levels (<10 mg/l (as NO_3) (EEA, 1999)) but do not exceed the Drinking Water Directive standard (50 mg/l as NO_3). Elevated mean nitrate concentrations in 1996 and 1997 are mostly caused by single very high values. However, although mean levels do not exceed the Drinking Water Directive Maximum Allowable Concentration, according to the latest European Commission report (EC 2002),
20 % of EU stations had concentrations in excess of the Maximum Allowable Concentration and 40 % were in excess of the guide value (25 mg/l as NO_3) in 1996-1998. Countries showing an overall increase in nitrate concentrations in groundwater are France and Sweden.

Key message

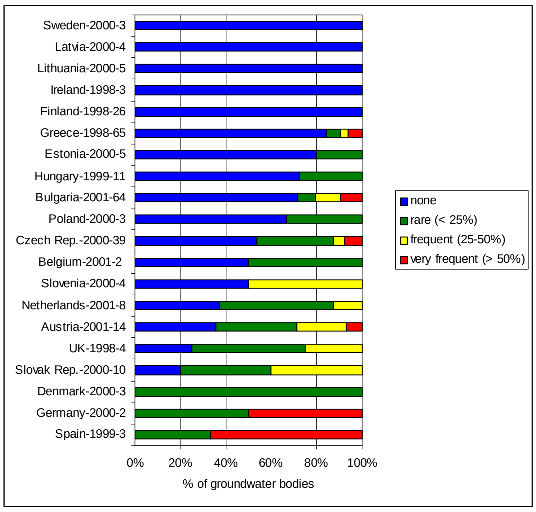
☹ There is no evidence of a decrease (or increase) in levels of nitrate in Europe's groundwaters though nitrate drinking water limit values are exceeded in around one-third of the groundwater bodies for which information is currently available.

Figure 4.2 Temporal development of nitrate mean values in groundwater bodies



Notes: The figure compares 3 time series containing different numbers of groundwater bodies, time spans and countries. It also shows the Drinking Water Directive's Maximum Allowable Concentrations and Guide levels, and the typical background concentration.
1993 to 1999 time series: Austria, Belgium, Bulgaria, Denmark, Estonia, Spain, Hungary, Lithuania, Latvia, Netherlands, Slovenia, Slovak Rep.
1993 to 2000 time series: Austria, Belgium, Bulgaria, Denmark, Estonia, Lithuania, Latvia, Netherlands, Slovenia, Slovak Rep.
1989-1999 time series: Bulgaria, Denmark, Estonia, Hungary, Lithuania, Netherlands, Slovak Rep.
Source: EUROWATERNET-Groundwater, 2002

Figure 4.3 Percentage of sampling sites in groundwater bodies where annual mean values exceed 50 mg/l nitrate



Source: EUROWATERNET, Groundwater, 2002

Policy Question 1: *Are nutrient and organic matter pollution decreasing?*

Organic matter in rivers

Key message
☺ The organic pollution of rivers has markedly decreased in the 1990s.

Biochemical oxygen demand and ammonium are key indicators of the oxygen content of water bodies. Concentrations of these determinands are normally raised as a result of organic pollution, caused by discharges from wastewater treatment plants, industrial effluents and agricultural runoff. High biochemical oxygen demand levels indicate poor chemical and biological quality of river water and may have the effect of reducing the biodiversity of aquatic communities and reducing microbiological quality.

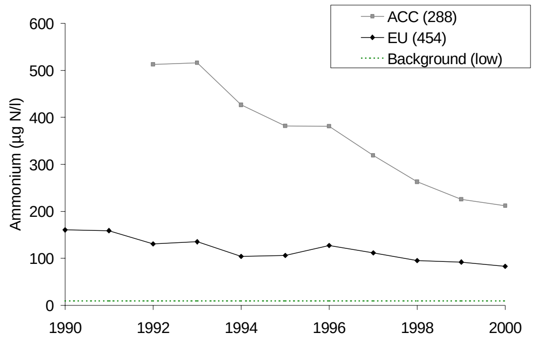
Increased industrial and agricultural production, coupled with more of the population being connected to sewerage, has resulted in increases in discharges of organic waste in most European countries since the 1940s. In many major European rivers, the oxygen decreased to low levels and the ecological quality was heavily affected. For example, the River Thames had no resident fish in the London reaches in the 1950s.

Biochemical oxygen demand generally decreased in the 1990s, by 20-30 % and 40-60 % respectively. This reduction in organic pollution in the EU countries during the 1990s was largely due to the Urban Waste Water Treatment Directive, which increased the level of treatment of wastewater. There has also been some investment in improving wastewater treatment in the Accession countries but the decline in organic pollution in these countries is probably mainly to do with declines in heavy industry.

The levels of biochemical oxygen demand and ammonium are lower in the EU countries than in the Accession countries. The largest decreases in ammonium have been observed in those countries with highest concentrations in the beginning of the 1990s. However, concentrations of ammonium are still way above background levels.

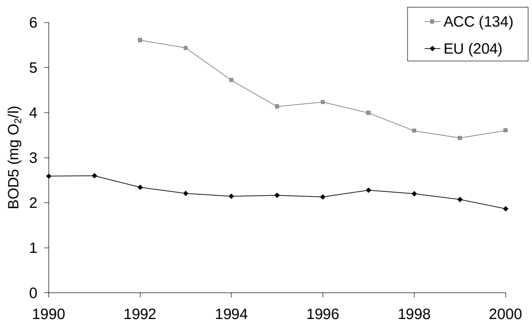
The concentrations of ammonium have decreased in the rivers of the EU and Accession countries in the 1990’s. The lowest levels of ammonium are found in Finland, with the new Baltic States, the UK and Denmark also having ammonium levels generally below 100 µg N/l. The highest ammonium concentrations are found in Poland, Germany, Hungary and Bulgaria, where significant improvements were made in the 1990s with ammonium levels being more than halved.

Figure 4.4 Concentration of total ammonium in rivers in EU and Accession countries



Number of stations in brackets.
EU countries: Denmark, Germany, Finland, France, Sweden, UK.
Accession countries: Bulgaria, Estonia, Hungary, Latvia, Lithuania, Poland, Slovenia, Slovak Rep.
Background or natural levels of ammonium in rivers will vary across Europe and from river type to river type. The figure above gives a level that might be considered to be at the lower level of the ranges reported to be representative of ‘background’ concentrations. Ammonium exerts a demand on oxygen in water as it is transformed to oxidised forms of nitrogen. In addition it is toxic to aquatic life at certain concentrations in relation to water temperature, salinity and pH.
Source Waterbase, ETC-WTR

Figure 4.5 Concentration of biochemical oxygen demand in rivers in EU and Accession countries



Number of stations in brackets.
EU countries: Denmark, France, UK
Accession countries: Bulgaria, Hungary, Slovenia, Slovak Rep.
Background levels of biochemical oxygen demand are difficult to quantify and are likely to be at or below the analytical method of measurement i.e. between 1 and 2 mg O_2/l. Source Waterbase, ETC-WTR

Policy Question 1: *Are nutrient and organic matter pollution decreasing?*

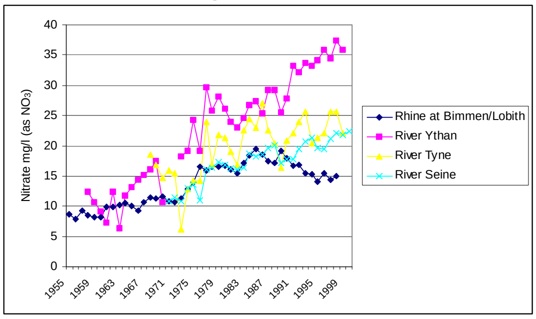
Nutrients in rivers

Large inputs of nutrients arising from human activities into rivers can lead to eutrophication, adversely affecting the ecology and limiting the use of rivers for drinking water abstraction and recreation. Nutrients occur naturally but it is difficult to determine precise background concentrations for different types of river. Generally phosphate background concentrations are approximately 10 µg/l as P and for nitrate are between 0.4 to 4 mg/l as NO_3.

In Western Europe and Accession countries, nutrient levels are above these background levels. In the case of phosphate, concentrations above background levels may be having significant impacts on the ecological status of many rivers particularly as phosphorus is the limiting nutrient in many freshwater systems. The levels of phosphate have decreased in Western and Accession countries in the 1990s, and in Northern Europe are close to background levels. The levels of nitrate are highest in the rivers of Western Europe where agriculture is the most intensive and lowest in Northern Europe where levels are within background ranges. Levels in the Accession countries are above background levels and have remained relatively unchanged throughout the 1990s. The median concentration in Western Europe has declined throughout the 1990s.

Nitrate concentration increases are evident in four rivers for which there is a long time series available. These are the river Rhine in Germany, the River Ythan and the River Tyne in Scotland and the River Seine in France. Only the River Rhine has shown recent decreases in levels.

Figure 4.8 Trends in nitrate concentrations since 1950s in some European rivers



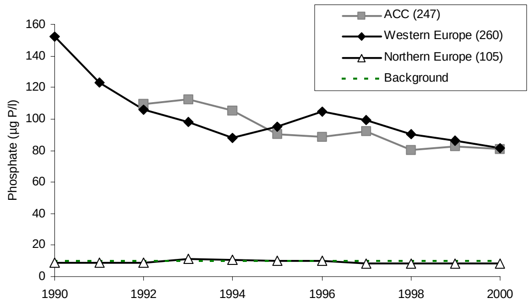
Sources: UBA, 2001 (Rhine), SEPA 2002 (Tyne and Ythan) and Waterbase (Seine)

Key messages

☺ Concentrations of phosphate have decreased in the rivers of the EU and Accession countries during the 1990s reflecting the general improvement in wastewater treatment over this period.

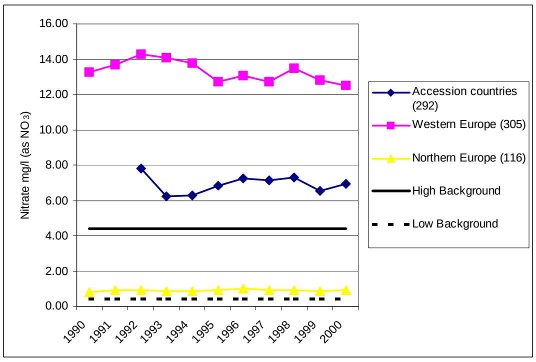
☹ Nitrate concentrations in most EEA rivers are still above natural levels with concentrations being particularly elevated in those Western European countries where agriculture is the most intensive.

Figure 4.6 Phosphate in rivers in western and northern Europe and in accession countries



Notes: Concentrations are the median of the annual average concentrations at each monitoring station. Numbers of stations are shown in brackets.
Western Europe: Denmark, Germany, France, UK: Northern Europe: Finland, Sweden:
Accession countries: Bulgaria, Estonia, Hungary, Latvia, Lithuania, Poland, Slovenia, Slovak Rep.
Source: EUROWATERNET-Waterbase, ETC/WTR, 2002

Figure 4.7 Nitrate concentrations in rivers in western and northern Europe and in accession countries



Notes:
Concentrations are the median of the annual average concentrations at each monitoring station. Numbers of stations are shown in brackets.
Western Europe: Denmark, France, Germany, UK:
Northern Europe: Finland, Sweden:
Accession countries, Bulgaria, Estonia, Hungary, Lithuania, Latvia, Poland, Slovenia, Slovak Rep.
Source: EUROWATERNET-Waterbase, ETC/WTR, 2002

Policy Question 1: *Are nutrient and organic matter pollution decreasing?*

Phosphorus in lakes

It has been recognised since the 1970s that the discharge of anthropogenic nutrients has caused eutrophication in many European lakes. Eutrophic lakes exhibit increased phytoplankton growth (in particular diatoms and blue-green algae) which can make the water turbid and unattractive. Some algal blooms produce toxins and also tastes and odours that make it unsuitable for water supply. Low oxygen levels due to degradation of dead algae also occur leading to the exclusion of fish and higher aquatic plants.

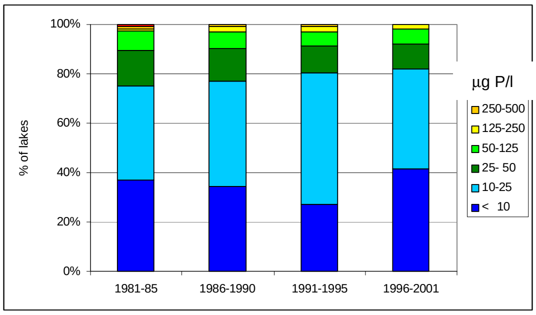
Lakes tend to take longer to recover from eutrophication than rivers since they generally have lower flushing rates and huge reserves of phosphorus that can be released from the sediment. In freshwater bodies phosphorus is usually the limiting nutrient for algal growth so its concentration gives an indication of the trophic status of a lake.

The proportion of lakes and reservoirs with low phosphorus concentrations (<25 µg P/l) has increased in the last 20 years and the proportion with relatively high concentrations (>50 µg P/l) has decreased in the last 20 years. This indicates that eutrophication in European lakes is decreasing. In the past, urban wastewater has been a major source of nutrient pollution but recently treatment has improved and outlets have been diverted away from many lakes. Diffuse pollution, particularly from agriculture, continues to be a problem. Phosphorus enrichment in lakes is a greater problem in Accession and Western countries than in the Northern countries. This is because the Northern countries have lower population densities, lower agricultural intensities and a longer tradition to remove phosphorus from wastewater.

In two large lakes which were previously highly polluted by phosphorus, the phosphorus concentrations have steadily decreased over the last decades particularly in response to control of point sources (e.g. Bodensee and Ijsselmeer. In two other examples (Loughs Neagh and Erne) concentrations have steadily increased in spite of reducing point source loads. This is because of a steady build up of a surplus of phosphorus (arising from fertilisers) in the soils in the catchments draining into these two lakes.

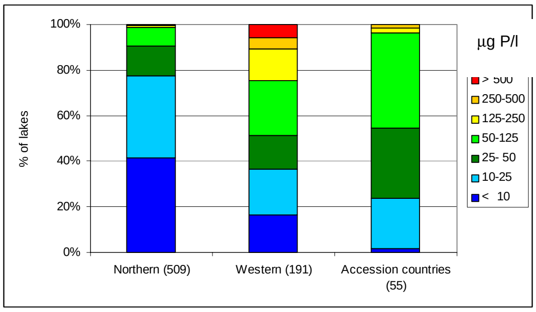
Key messages
☺ Eutrophication of European lakes is decreasing.
☹ However, there are still many lakes and reservoirs with high concentrations of phosphorus due to human activities.
☹ Phosphorus concentrations are highest in lakes in the Accession countries and lowest in the Northern countries.

Figure 4.9 Change in average summer concentration of phosphorus in lakes



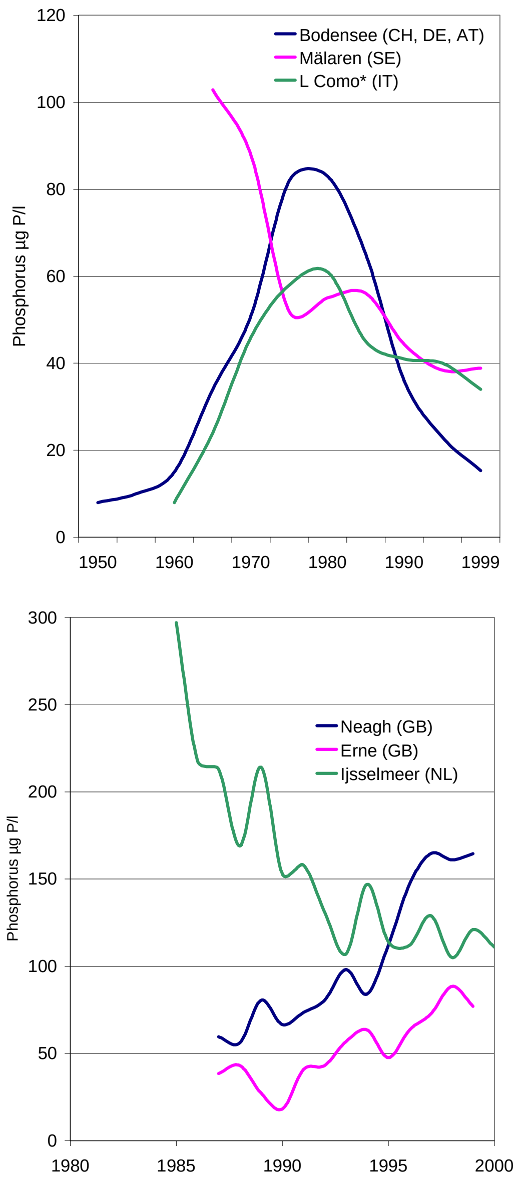
Based on 339 lakes
Source EUROWATERNET-Lakes, 2001

Figure 4.10 Current phosphorus concentrations in lakes in parts of Europe



Northern: Iceland, Norway, Sweden, Finland
Western: Austria, Germany, Denmark, Spain, France, Ireland, Netherlands, UK
Accession countries: Estonia, Latvia, Lithuania, Poland, Slovenia, Hungary, FYR Macedonia
Source EUROWATERNET-Lakes, 2001

Figure 4.11 Trends in total phosphorus concentrations in some European large lakes



Source: compiled by ETC/WTR from SoE reports

Policy Question 1: *Are nutrient and organic matter pollution decreasing?*

Nutrients in coastal and marine waters

In marine and coastal waters increased nutrient loads result in increases in phytoplankton biomass and changes in phytoplankton species composition which effect food web dynamics and light conditions. Eutrophication is a particular problem in semi-enclosed coastal water bodies e.g. sea lochs, where increased biomass can cause oxygen depletion. In addition, there are sometimes increases in toxic species of phytoplankton.

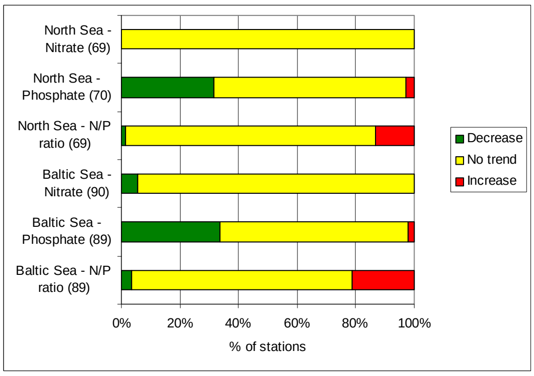
The mean winter surface concentrations of nitrate and phosphate and the nitrate/phosphate ratio are used to assess nutrient status since in winter biological uptake is at its lowest and nutrient concentrations are at their highest. The optimum N/P ratio for phytoplankton growth is 16:1. Lower ratios indicate nitrate limitation and higher ratios indicate phosphate limitation to further growth.

There have been significant decreases in riverine and direct loads of nitrogen and phosphorus into the Baltic and North Seas since 1985 (see Figure 4.14). However, no trend is observed in winter surface nitrate concentrations in the Greater North Sea (Figure 4.12 and Map 4.1 and 4.2). Also generally no trend is observed in the Baltic Sea Area, except for a decreasing trend at a few Danish, Finnish and Swedish stations. In the Black Sea, a slight decrease of nitrogen concentrations in the Romanian coastal waters and a steady decline in Turkish waters at the entrance of Bosphorus are reported (Black Sea Commission 2002).

Decreasing trends are observed in winter surface phosphate concentrations at a number of stations in the Belgian, Dutch, Norwegian and Swedish coastal waters of the North Sea and Skagerrak, and in the Danish, German, Lithuanian and Swedish waters of the Baltic Sea area. Increasing trends are observed at two Finnish coastal stations in the Gulf of Finland due to hypoxia and upwelling of phosphate-rich bottom water in the late 1990s, and at a few Belgian and German coastal North Sea stations.
The phosphate concentrations are mainly low in the Mediterranean Sea but some hotspots are found on the west coast of Italy.

Key message:
☹ Nutrient concentrations in Europe's Seas have generally remained stable over recent years, though a few stations in the Baltic, Black and North (phosphate only) Seas have demonstrated a slight decrease in nitrate and phosphate concentrations. Fewer stations in the Baltic and North Seas also showed an increase in phosphate concentrations.

Figure 4.12 Trends in nitrate and phosphate concentrations, and N/P ratio in North and Baltic Seas

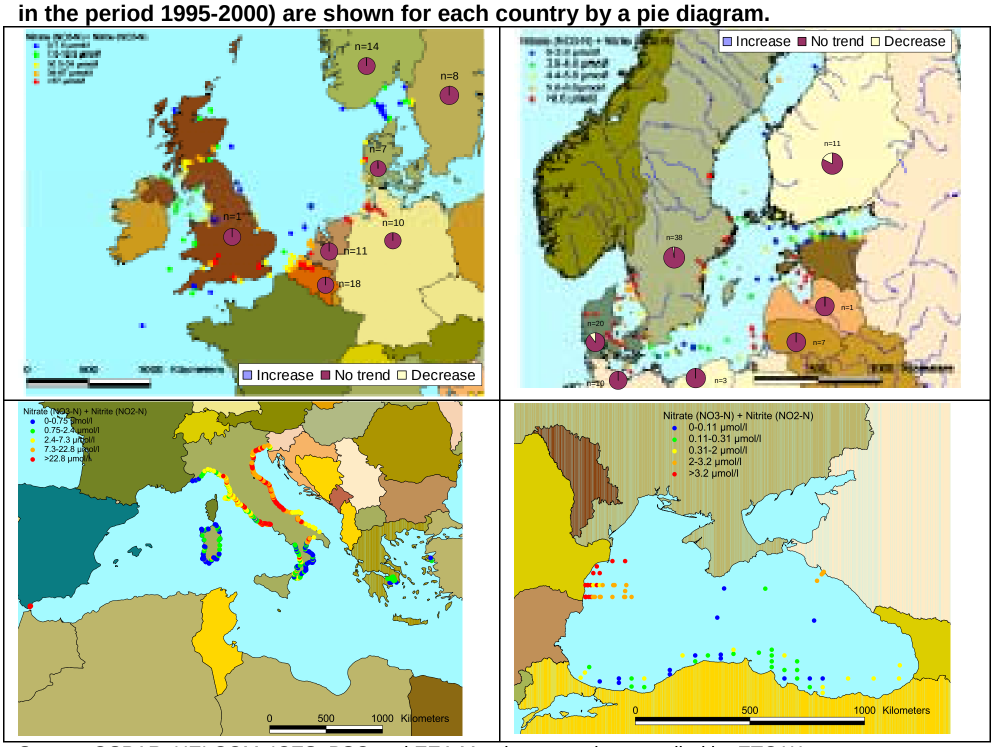


Notes:
Trend analyses are based on a time series 1985-2000 with each monitoring station having at least 3 years data in the period 1995-2000. Number of stations in brackets.
Baltic Sea data from: Denmark, Finland, Germany, Latvia, Lithuania, Poland, Sweden.
North Sea data from: Belgium, Denmark, Germany, Netherlands, Norway, Sweden, UK.
Source: OSPAR, HELCOM, ICES, BSC and EEA Member countries compiled by ETC Water.

In the Black Sea there is no general trend in phosphate concentrations but the Black Sea Commission, 2002 has reported decreases in Turkish waters at the entrance to Bosphorus (Black Sea Commission 2002).

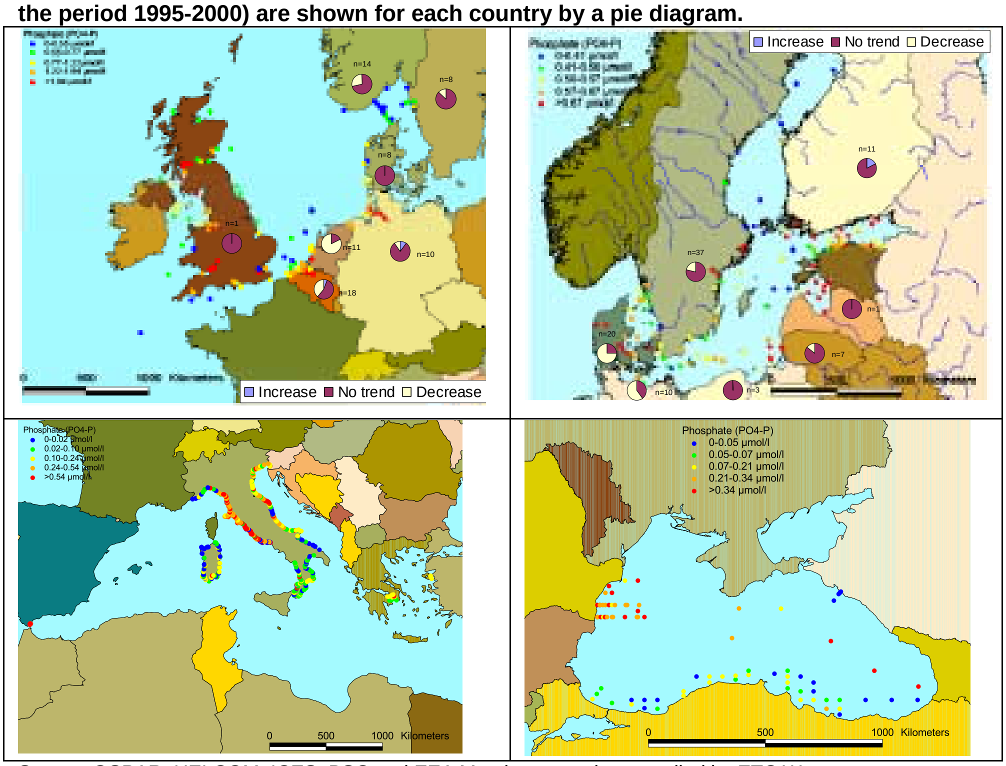
The N/P ratio is increasing at the Dutch and Norwegian stations in the North Sea but decreasing in the outer Elbe Estuary. The ratio is also increasing at some stations in the Baltic Sea and in the Mediterranean Sea ratios are very high all along the east coast of Italy indicating phosphorus limitation. In the Black Sea the ratio is generally low (nitrogen limitation) except at a few Romanian stations where ratios of >32 are found.

Map 4.1 Mean (1995-2000) winter (Jan.-Feb./Mar.) surface (0-10 m) concentrations of nitrate + nitrite in sea water. In addition, the results of trend analyses of time series 1985-2000 (with at least 3 years data in the period 1995-2000) are shown for each country by a pie diagram.



Source: OSPAR, HELCOM, ICES, BSC and EEA Member countries compiled by ETC Water.

Map 4.2 Mean (1995-2000) winter (Jan.-Feb./Mar.) surface (0-10 m) concentrations of phosphate in sea water. In addition, the results of trend analyses of time series 1985-2000 (with at least 3 years data in the period 1995-2000) are shown for each country by a pie diagram.



Source: OSPAR, HELCOM, ICES, BSC and EEA Member countries compiled by ETC Water.

Policy question 2: *Are discharges of nutrients and organic matter from socio-economic sectors decreasing?*

Discharges of organic matter from point sources

Organic pollution is caused by discharges of human wastewater and industrial effluents, particularly industries that process organic matter such as wood processing and the food industry. In addition, the chemical industry and agricultural runoff (manure and slurry) also result in high BOD and ammonium levels, which are key indicators of organic pollution.

Organic matter discharged from urban wastewater treatment plants has decreased in Denmark, Finland, the Netherlands and the UK. Organic matter discharged from point sources in the Accession countries dramatically decreased in the 1990s. This may be partly due to the deep economic recession that occurred between 1990 and 1993, and the consequent decline in highly polluting heavy industry. Although their economies have since picked up and industrial output has increased, there has been a shift towards less polluting industries and improved wastewater treatment.

Several types of industry that discharged large amounts of organic matter in the 1970s and 1980s, have since markedly reduced their discharges. This is because many industries have become cleaner rather than because production from these industries has declined. In fact in many cases production has increased whilst pollution has declined.

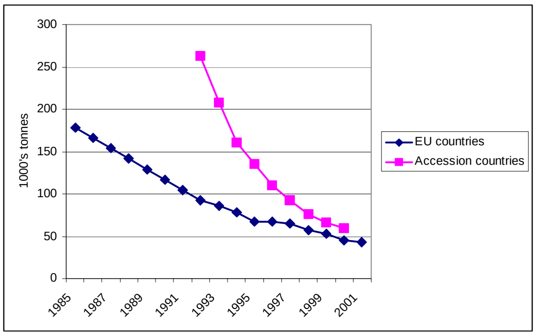
For example, discharges of organic matter from the European pulp and paper industry have declined as more mills now have secondary treatment of their effluents. However, the total amount of paper produced has increased during this time period. The move towards cleaner technologies is partly driven by the European Directives such as the Integrated Pollution Prevention and Control (IPPC) Directive which requires large facilities to use the Best Available Techniques (BAT) to make radical environmental improvements.

Key messages:

☺ Over the past 15 to 30 years biological treatment of wastewater has increased and organic discharges have consequently decreased across most of Western Europe.

☺ There have been marked reductions in the discharge of organic matter in the Accession countries during the 1990s, and in the five countries for which data are available, organic matter from point sources declined by more than 75 % from 1992 to 2000.

Figure 4.13 Discharge of organic matter from point sources



Notes:
Discharge of organic matter (biochemical oxygen demand) from urban wastewater treatment works in EU countries (Denmark, Finland, Netherlands, UK (E&W)), and from all point sources (e.g. urban wastewater treatment works and industry) in Accession countries (Czech Rep., Estonia, Latvia, Lithuania, Slovak Rep.).
Sources:
National SOE reports.

Policy question 2: *Are discharges of nutrients and organic matter from socio-economic sectors decreasing?*

Loads of nutrients discharged to sea

There is a direct relationship between riverine and direct discharges of nitrogen and phosphorus and the concentration of nutrients in coastal waters, estuaries, fjords and lagoons, which in turn affect their biological state. Measures to reduce the input of anthropogenic nutrients and to protect the marine environment are required by the Mediterranean Action Plan, Helsinki Convention 1992, OSPAR Convention 1998, and the Black Sea Convention.

In terms of phosphorus discharges to the North Sea there have been significant reductions in the loads from urban wastewater treatment works, industry and other sources between 1985 and 2000. The reduction from agriculture has been less great and this source was the largest in 2000. Nitrogen discharges to the North Sea have decreased significantly from all four sources between 1985 and 2000 with agriculture being the major source in 2000.

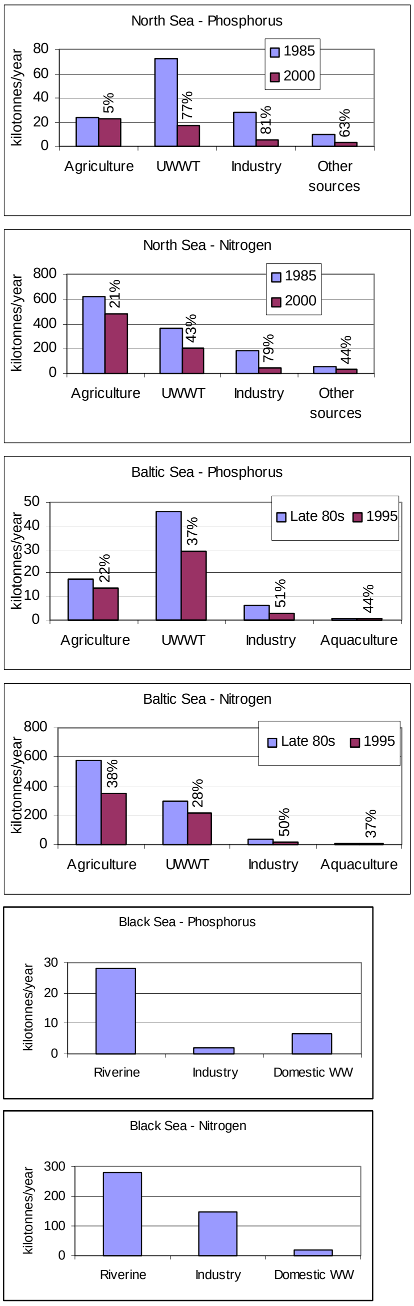
Even though the data for the Baltic Sea are less recent, they give a similar picture to the North Sea with significant reductions in discharges of nitrogen and phosphorus from agriculture, urban wastewater treatment works, industry and aquaculture. In 1995 the major source of phosphorus and nitrogen to the Baltic Sea was urban wastewater treatment works and agriculture, respectively.

Data for the Black Sea are less comprehensive than for the Baltic and North Seas, but indicate that riverine discharges are the largest sources of nitrogen and phosphorus. For example, the Danube contributes to around 65% of the total nitrogen and phosphorus load for all sources.

Comprehensive data are also not available for the Mediterranean Sea but all coastal cities discharge their (treated or untreated) sewage to the sea and only 4% have tertiary treatment indicating that the nutrient input from this source maybe high. Agriculture is also intensive in the region and 80 rivers have been identified as significantly contributing to the pollution of the Mediterranean (EEA 1999).

Key messages
☺ Loads of both phosphorus and nitrogen from all quantified sources to the North Sea and Baltic Sea have decreased since the 1980's.

Figure 4.14 Apportionment of loads discharged into Europe's Seas



Note: Urban wastewater treatment (UWWT). Percentage reductions between 1985 and 2000 for Baltic and North Seas also given.
Sources: North Sea Progress Report 2002; HELCOM 2002, http://www.vyh.fi/eng/orginfo/publica/electro/fe524/fe524.htm); Black Sea Environmental Programme 1998

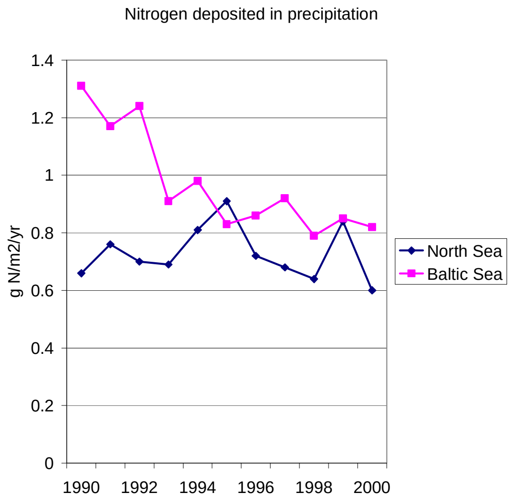
Policy question 2: *Are discharges of nutrients and organic matter from socio-economic sectors decreasing?*

Atmospheric deposition of nitrogen to marine and coastal waters

Atmospheric deposition of oxidised or reduced nitrogen compounds can be considerable throughout Europe and can be a significant source of the total input of nutrients to surface water systems.

Key message:
☹ The total quantity of nitrogen deposited into the North Sea from the atmosphere has remained relatively stable throughout the 1990s.
☺ Nitrogen depositions to the Baltic Sea have declined in the 1990s.

Figure 4.15 Nitrogen deposition in precipitation in the North Sea and Baltic Sea



Source: EMEP, ETC/ACC

Policy question 2: *Are discharges of nutrients and organic matter from socio-economic sectors decreasing?*

Development of urban wastewater treatment

Over the last twenty years, marked changes have occurred in the proportion of the population connected to waste water treatment as well as in the wastewater treatment technology involved.

In the Northern countries most of the population are today connected to waste water treatment plants with tertiary treatment which efficiently removes nutrients and organic matter from the waste water. In the central EEA countries more than half of the wastewater is treated by tertiary treatment, a quarter by only biological treatment which removes most of the organic matter and the ammonia. Southern countries and the AC countries only for the moment have around half of the population connected to waste water treatment plants. 30 to 40 % of the population are connected to secondary or tertiary treatment.

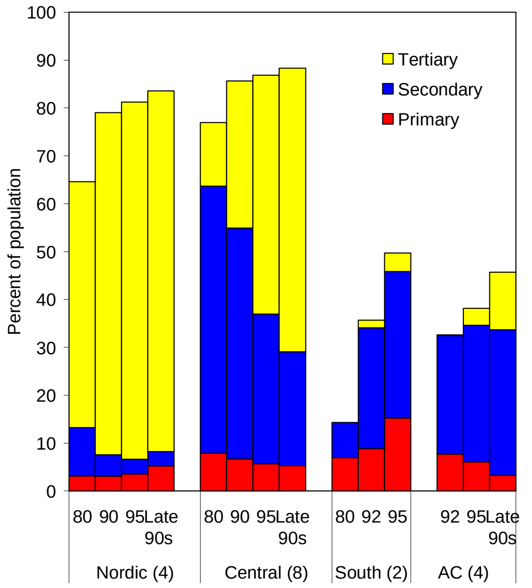
The improvement in wastewater treatment was due to implementation of the Urban Waste Water Treatment Directive (see the status of implementation at later indicator) and resulted in marked lower discharge of organic matter and nutrients to water.

In the countries included in Figure 4.17 the percentage of population connected to tertiary treatment increased from 40 % to 80 % during the 1990's. Over the same period the discharge of phosphorus and nitrogen from wastewater treatment decreased by 60 % and 30 % respectively. This difference reflects that nearly all the tertiary treatment plants have phosphorus removal while only some of the plants, in particular the large plants, have nitrogen removal.

Key message
☺ In several countries in north-western Europe there has in the 1990s been a marked increase in the population connected to tertiary wastewater treatment resulting in marked reductions in phosphorus and nitrogen emissions.

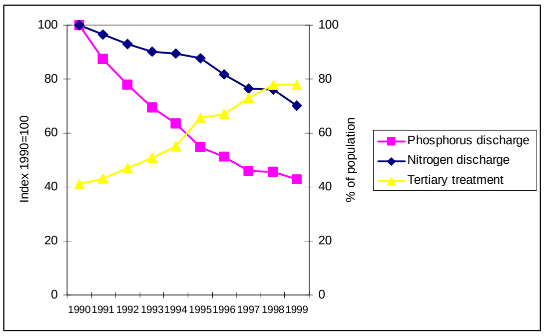
Key messages
☺ Wastewater treatment in all parts of Europe has improved significantly since the 1980s.
☹ However the percentage of population connected to wastewater treatment is relatively low in southern Europe and in the Accession countries.

Figure 4.16 Changes in wastewater treatment in regions of Europe between 1980s and late 1990s



Notes: Only countries with data from all periods included, the number of countries in parentheses. Nordic: Iceland, Norway, Sweden, Finland. Central EEA: Austria, Ireland, United Kingdom, Luxembourg, Netherlands, Germany, Denmark Switzerland. Southern: Greece and Spain. AC: Bulgaria, Estonia, Hungary and Poland
Sources: EEA – ETC/WTR based on Member States data reported to OECD / EUROSTAT Joint Questionnaire 2000.

Figure 4.17 Trend in discharge of phosphorus and nitrogen from urban wastewater treatment works compared with percentage of population connected to tertiary treatment



Notes: Nitrogen and phosphorus loads indexed with 1990 = 100. Data from Denmark, Finland, Netherlands, Norway (no nitrogen) and Sweden.
Sources: National SOE reports

Policy question 2: *Are discharges of nutrients and organic matter from socio-economic sectors decreasing?*

Use of fertilisers

A major source of nitrogen pollution is agriculture since nitrogen fertilisers and manure are used on arable crops to increase yields and productivity. In the EU mineral fertilisers account for almost 50 % of inputs into agricultural soils and manure for 40 % (other inputs are biological fixation and atmospheric deposition) (EC (2002) Report COM(2002)407). When the amount of fertiliser applied is in excess of the amount that can be utilised by the crop, the nitrogen is easily lost and ends up polluting water bodies.
Both increases in fertiliser use, and in animal manure to be disposed of, constitute a potential source for run-off of nutrients to inland waters.

In general the use of both types of fertiliser per unit of arable land is higher in Western Europe than in Eastern Europe. This reflects the less intensive arable agricultural practices in the latter countries.

Key messages

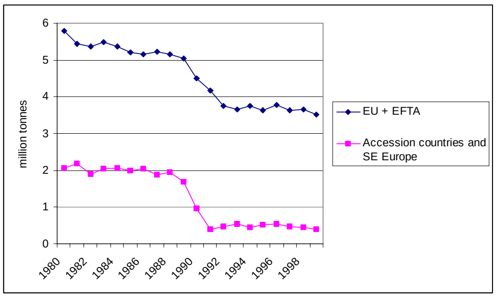
☺ Phosphate fertiliser consumption has been decreasing in both the EU and Accession countries since the 1980s.

☹ Nitrogen fertiliser consumption increased until the late 1980s and then started to decline but in recent years it has increased again in the EU and EFTA countries.

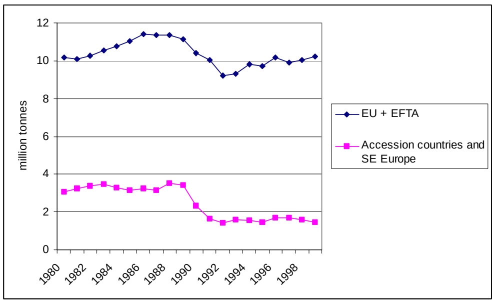
☹ Phosphate and nitrogen fertiliser consumption per hectare of arable land is higher in the EU and EFTA countries than in the Accession countries. Mineral fertilisers are still a very important source of nutrient pollution.

Figure 4.18 Changes in a) phosphate and b) nitrogenous fertiliser use

a)

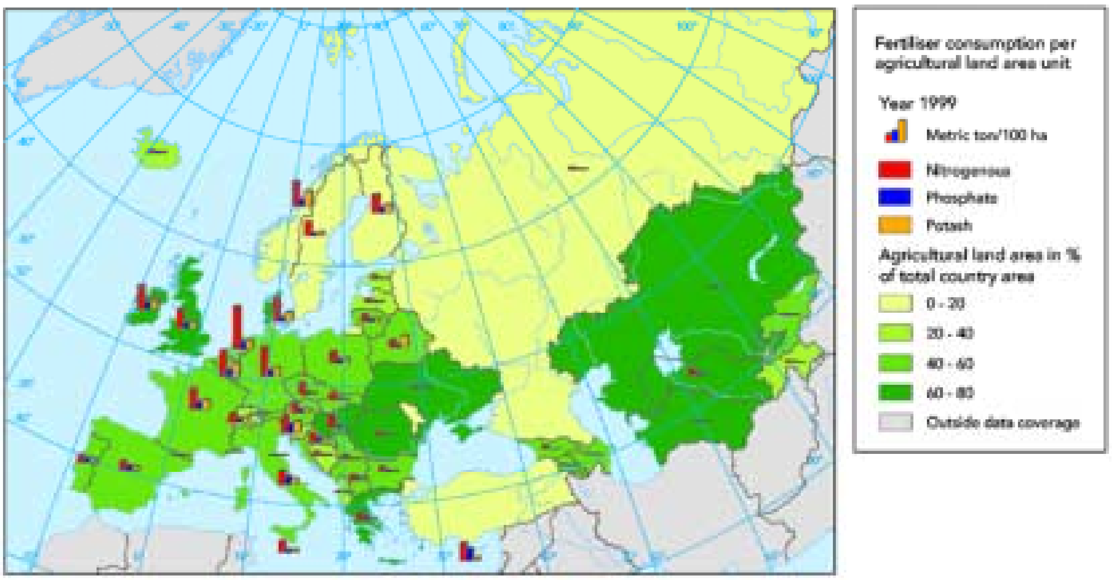


b)



Notes:
As nitrate generally moves relatively slowly in soil and groundwater there will often be a significant time lag between changes in agricultural practices and changes in nitrate concentrations in groundwater – typically between one and 20 years depending on the situation. The time frame in Figure 4.18 was chosen to reflect this potential time lag.
EU + EFTA: Austria, Belgium-Luxembourg, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom
Accession countries and SE Europe: Albania, Bulgaria, Cyprus, Hungary, Malta, Poland, Romania
Source: FAO

Map 4.3 Phosphate and nitrogen fertiliser usage per hectare of arable land (tonnes/ha) in Europe



Source: FAO

Policy question 2: *Are discharges of nutrients and organic matter from socio-economic sectors decreasing?*

Numbers of livestock

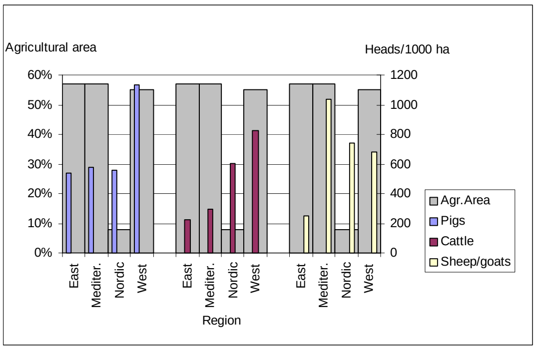
Key message
☹ Livestock density is high in Western Europe. In combination with the high percentage of agricultural land in these countries, there is a high potential for nitrogen and phosphorus pollution.

The Nitrates Directive sets a limit for the amount of livestock manure applied to land each year, including by the animals themselves, of 170 kg N per hectare. This amount may be calculated on the basis of animal numbers. Livestock densities per agricultural area are highest in Western Europe both as regards pigs and cattle. The Northern region has relatively high densities of cattle, whereas the Mediterranean region has the highest densities of sheep and goats. Eastern Europe has low densities of both pigs, cattle and sheep/goats.

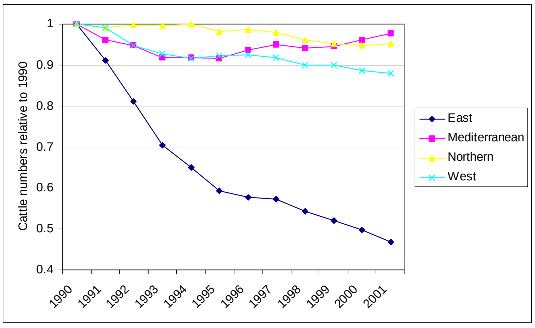
The most marked change in the numbers of livestock in the 1990's is a drastic reduction in both pigs and cattle in Eastern Europe caused by the economic problems during the transition period. The Mediterranean region has had a big increase in numbers of pigs and a smaller increase in cattle in the late 1990's. In northern and western countries of Europe there have been relatively minor reductions in cattle numbers. Northern countries have also seen a reduction in pig numbers whereas in western countries pig numbers remained relatively stable.

Figure 4.19 Livestock densities (a) and relative changes in cattle (b) and pig (c) numbers in different regions of Europe since 1990

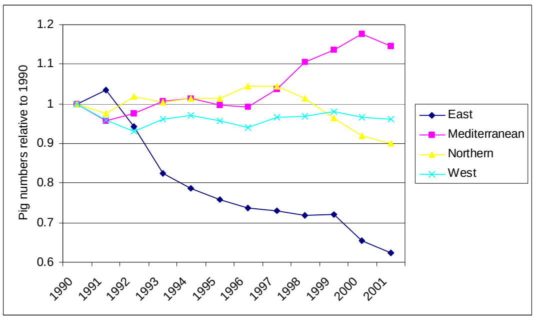
a)



b)



c)



Countries:
East: Bosnia-Herzegovina, Bulgaria, Croatia, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Rep.
Mediterranean: Albania, Greece, Italy, FYR Macedonia, Malta, Portugal, Slovenia, Spain
Northern: Finland, Iceland, Norway, Sweden
West: Austria, Belgium, Luxembourg, Denmark, France, Germany, Ireland, Liechtenstein, Netherlands, UK
Source: FAO

Policy question 2: *Are discharges of nutrients and organic matter from socio-economic sectors decreasing?*

Nitrogen balance in agricultural soils

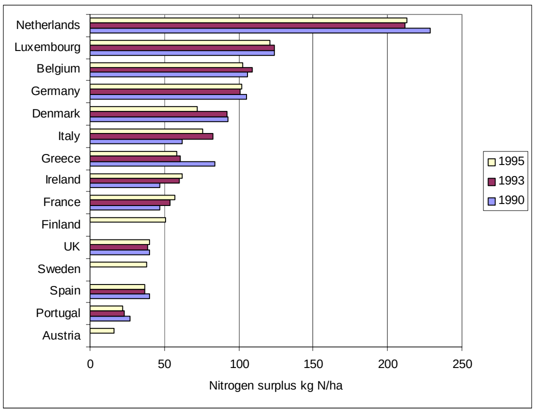
The nitrogen balance describes the input by mineral fertilisers, livestock manure, atmospheric deposition, biological nitrogen fixation and other inputs such as sewage sludge, and the output in form of harvested crops. The nitrogen surplus indicates the nitrogen which potentially can be lost to groundwater and surface waters and cause eutrophication problems.

The nitrogen surplus in the EU countries (Map 4.4) is generally 50-100 kg N per hectare of agricultural area but countries with very intensive agriculture such as the Netherlands have even higher surpluses. The nitrogen balance in the period 1990-1995 for the EU countries has remained nearly constant. The total input has been reduced by around 5 % but this is compensated by a decrease in the removal by harvested crops (output). The highest nitrate surpluses are found in areas with high densities of livestock breeding and also where there is intensive agriculture and inappropriate agricultural practices such as leaving bare soils in winter which increases nitrate loss.

Key message

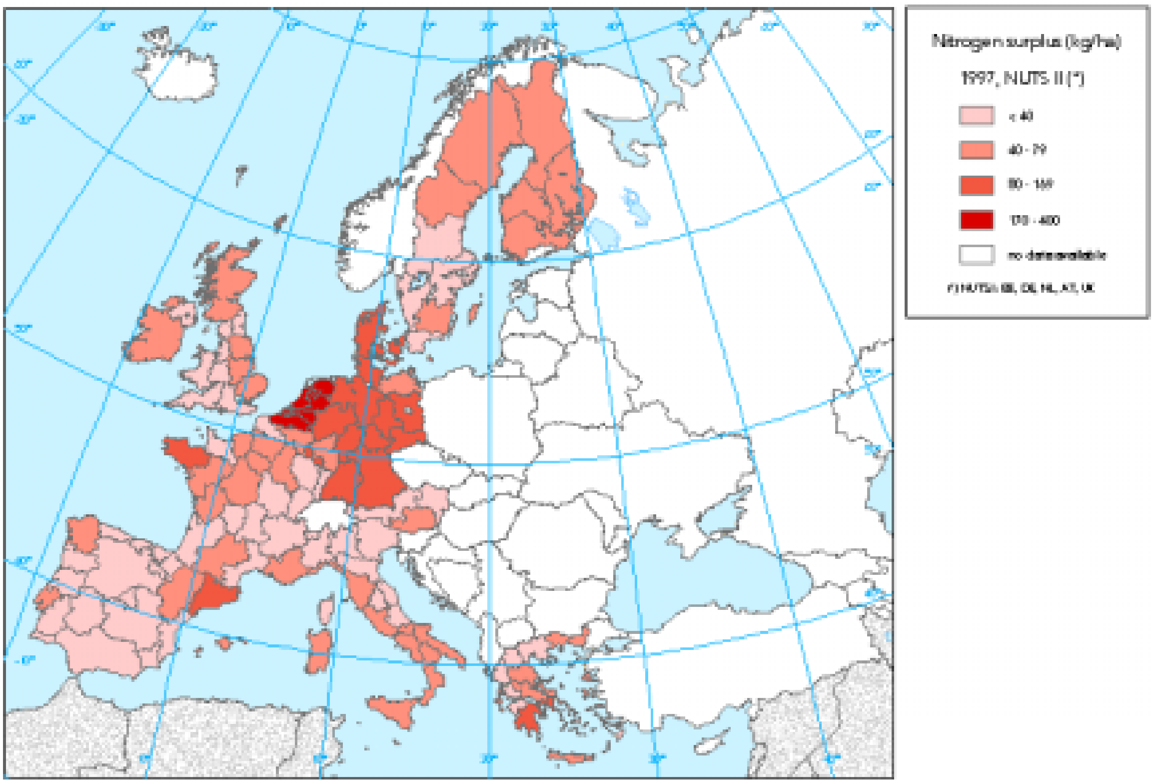
☹ There is a large nitrogen surplus in the agricultural soils of EU countries that can potentially pollute both surface and groundwaters.

Figure 4.20 Estimate of nitrogen balance for EU countries (kg N/ha)



Notes:
Source: Eurostat

Map 4.4 Nitrogen surpluses in Europe



Source: EU Commission Report COM (2002) 407

Policy question 3: *Are we enhancing the status of the aquatic ecosystems and lowering the adverse effects of organic pollution?*

Microbiological contamination of drinking water

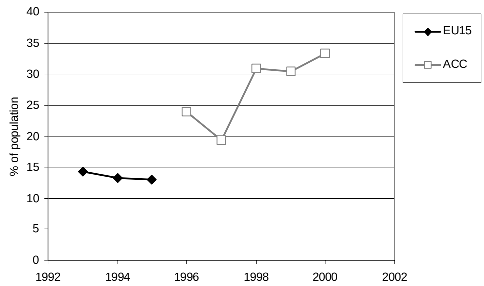
The pollution of water by organic matter arises from discharges from sewage treatment works and also from organic matter arising from animal husbandry. Both surface waters and groundwaters are used as for drinking water. Drinking water quality is of direct relevance to human health and reflects the levels of contaminants in the raw water (surface water and groundwater) and the efficiency of water treatment and water distribution systems. Levels of contamination with microbiological parameters indicate how well we are doing in lowering the adverse effects of pollution.

Since it is impractical to monitor for all specific pathogenic bacteria faecal indicator organisms are examined. Two of these are faecal coliforms and faecal streptococci. Ireland, Slovakia, Italy and Hungary had the highest percentage of samples exceeding the faecal coliform standard and Slovakia, Hungry and Italy had the highest percentage of samples exceeding the standard for faecal streptococci.

The relatively high percentage of population exposed to microbiological contamination of drinking water in the Accession countries compared to the EU countries is probably due to the economic situation leading to decreased levels of water treatment.

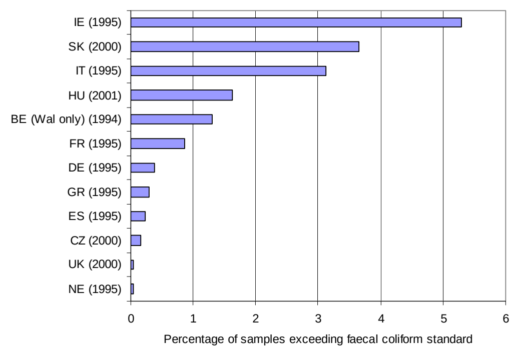
Key message
☹ There are still problems with microbiological contamination of drinking water, particularly in the Accession countries.

Figure 4.21 Percentage of population potentially exposed to microbiological contaminants in drinking water

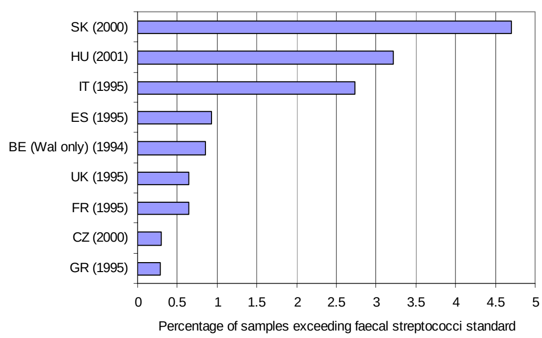


EU15: As % population of 9 countries that reported (Belgium, Germany, Greece, Spain, France, Ireland, Italy, Netherlands, UK.
Accession countries (ACC): As % population of 3 countries that reported (Hungary, Latvia, Estonia/
Source: DGEnv. Member States returns under the Reporting Directive for the period 1993 to 1995. Accession country data collected by ETC/WTR.

Figure 4.22 Percentage of samples exceeding the standard for a) faecal coliforms and b) faecal streptococci for the latest year available
a)



b)



Source: DGEnv. Member States returns under the Reporting Directive for the period 1993 to 1995. Accession country data collected by ETC/WTR.

Policy question 3: *Are we enhancing the status of the aquatic ecosystems and lowering the adverse effects of nutrient pollution?*

Nitrate in drinking water

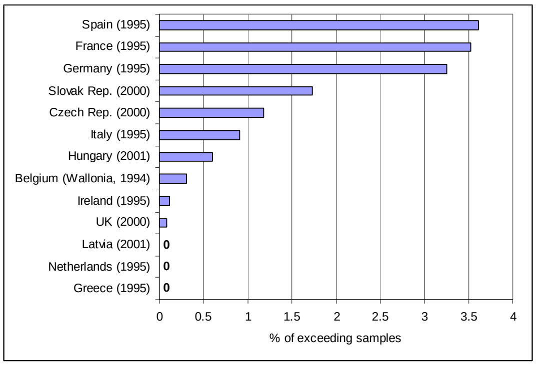
In the EU countries nitrate contamination is the most common problem identified in many national reports. Excess nitrate in drinking water is of particular concern in terms of human health, infants in particular (see indicator on nitrate in groundwaters). It is often a particular problem in rural water supplies, the standards of which are not necessarily reported or well monitored since they often only serve small populations. For example, in Belgium 29 % of 5 000 wells examined had nitrate levels in excess of 50 mg/l nitrate, the Drinking Water Directive standard (OECD EPR Belgium, 1997).

Many EEA countries have problems with nitrate contamination. For example, over 3 % of drinking water samples taken in France, Germany, and Spain exceeded nitrate standards. The significance of these exceedances has, however, not been quantified, as there is no complementary information on the duration and level of exceedance, and on the number of people exposed. In Accession countries the shallow wells in central and southern Poland are known to be contaminated, and in Bulgaria it is estimated that in the early 1990’s, up to 80 % of the population was exposed to nitrate levels greater than 50 mg/l (OECD EPR Bulgaria, 1995).

Key message

☹ Nitrate in drinking water is a common problem across Europe particularly from small supplies/wells in contaminated shallow groundwater.

Figure 4.23 Percentage of samples exceeding nitrate standards in drinking water



Notes: Latest year in brackets.
Source: DGEnv. Member States returns under the Reporting Directive for the period 1993 to 1995. Accession country's data collected by ETC Water.
National State of Environment Reports.

Water transparency in lakes

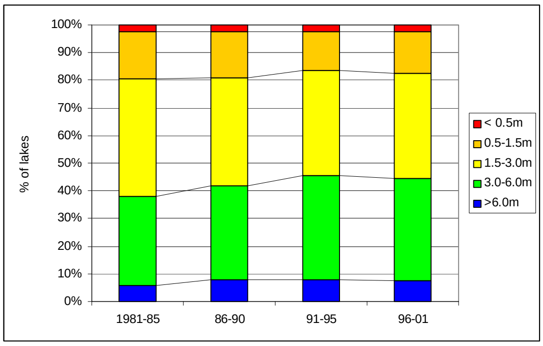
High nutrient concentrations promote algal growth resulting in high turbidity. This is a nuisance to the recreational use of lakes for bathing, fishing and the immediate visual impression. Large amounts of algae also adversely affect the entire lake ecosystem.

Transparency of lake water is commonly measured as by a Secchi disc. The disc is lowered into the water and the depth at which it is no longer visible from the surface is recorded. The summer Secchi depth in eutrophic lakes is generally less than in lakes that are not eutrophic. This is because of phytoplankton growth in eutrophic lakes that blocks out the light and decreases the clarity of the water. The average summer Secchi depth in European Lakes has increased since the 1980's (Figure 4.24) indicating decreasing eutrophication in these lakes resulting from the decrease in point source phosphorus loads in particular.

Key message

☺ The quality of water in terms of transparency has improved in European lakes since 1980 because of a reduction in concentrations of phosphorus resulting from measures to reduce discharges of phosphorus from point and other sources.

Figure 4.24 Change in average summer Secchi depth



Source WATERBASE, ETC/WTR. 314 lakes
Countries included, Austria, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Lithuania, Norway, Poland, Portugal, Spain, Sweden.

Policy question 3: *Are we enhancing the status of the aquatic ecosystems and lowering the adverse effects of organic pollution?*

Bathing water quality

The Bathing Water Directive (76/160/EEC) was designed to protect the public from accidental and chronic pollution which could cause illness from recreational water use. It lists a number of parameters to be monitored but the focus has been on bacteriological quality. Human enteric viruses are the most likely pathogens responsible for waterborne diseases from recreational water use but detection methods are complex and costly for routine monitoring, and so the main parameters analysed for compliance with the Directive are indicator organisms; total and faecal coliforms. Compliance with the mandatory standards and guide levels for these indicator organisms does not therefore guarantee that there is no risk to human health. In addition, studies have shown that even meeting guide values does not necessarily protect public health. However, since contamination arises from the discharge of effluents and also from diffuse sources, it is indicative of the general water quality.

In 2001, 97 % of coastal and 93 % of inland bathing waters complied with the mandatory standards, and 90 % of coastal and 72 % of inland bathing waters met guide values. Of the EU countries, Greece and Italy had the highest percentage of coastal waters reaching the guide values, Belgium and Finland the lowest in 2001. Ireland and Denmark had the highest percentage of inland bathing waters reaching the guide values, and Portugal and Spain the lowest.

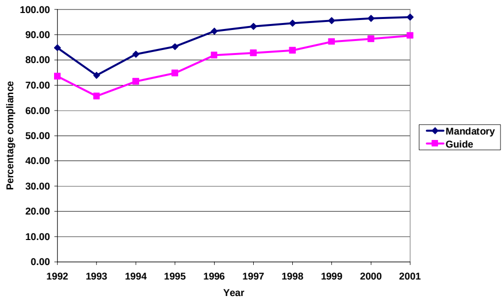
Key messages

☺ The quality of designated bathing waters (coastal and inland) has improved in Europe throughout the 1990's.

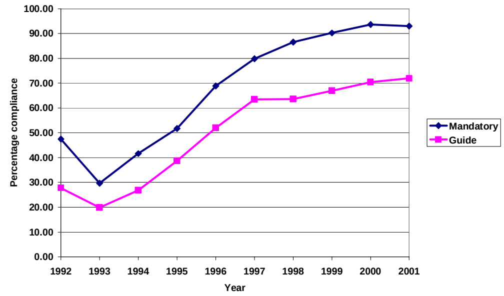
☹ Despite this improvement, 10 % of Europe's coastal and 28 % of inland bathing waters still do not meet (non-mandatory) guide values.

Figure 4.25 Compliance of (a) coastal and (b) inland bathing waters with mandatory and guideline values of the Bathing Water Directive

a)



b)

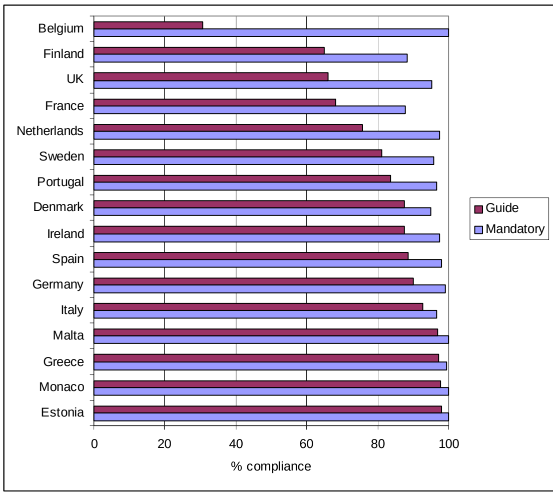


Notes: EU15 countries

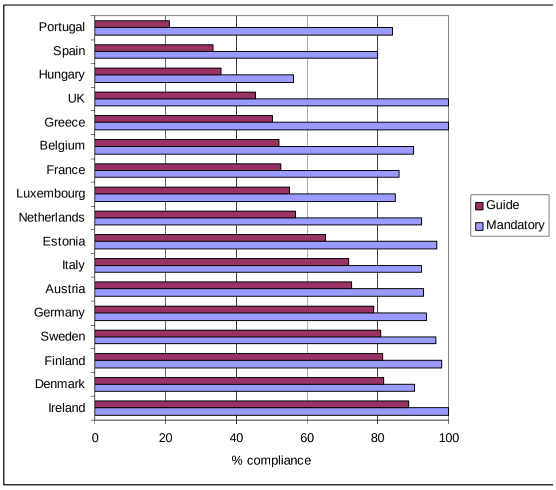
Source: EU Member States annual reports to the European Commission DG Environment.

Figure 4.26 Compliance in 2001 of (a) coastal and (b) inland waters bathing waters with mandatory and guideline values of the Bathing Water Directive

a)



b)



Note: Estonia quality is quoted according to their national standards rather than those in the Directive. Source: EU Member States annual reports to the European Commission DG Environment. Accession Countries ETC/WTR questionnaire returns from countries

Policy question 3: *Are we enhancing the status of the aquatic ecosystems and lowering the adverse effects of nutrient pollution?*

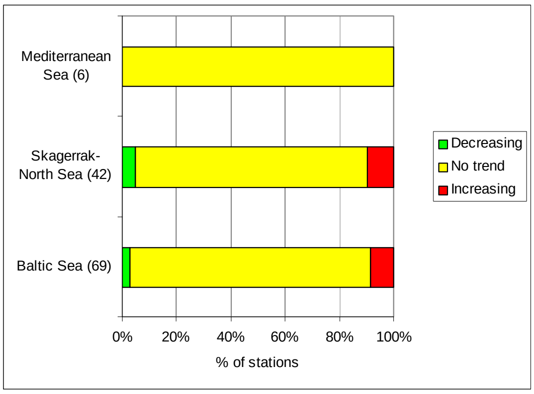
Chlorophyll in coastal and marine waters

The measurement of chlorophyll-a levels is also a way of monitoring eutrophication since in summer phytoplankton primary production and chlorophyll-a concentration is, in most areas, nutrient limited. The phytoplankton biomass expressed as chlorophyll-a determines the light conditions in the water column and so also affects the distribution of benthic vegetation. However, due to variations in freshwater run-off and hydrogeographic variability of the coastal zone and internal cycling processes, trends in chlorophyll-a concentrations as such can not be directly related to measures taken to reduce nutrient inputs. Concentrations are generally highest in estuaries and close to river mouths or big cities, and lowest in open marine waters which is also where the highest nutrient levels are found. A decreasing trend has been observed at a few stations in Danish estuaries, and increasing trend has been found at a few stations in Belgian, Finnish, Lithuanian and Swedish coastal waters (Figure 4.27).

Map 4.5 shows clear differences in the geographical distribution concentration levels of chlorophyll-like pigments, especially in the eastern and southern North Sea and in the Baltic Sea. There are also relatively high concentrations seen in the Black Sea close to the Danube delta.

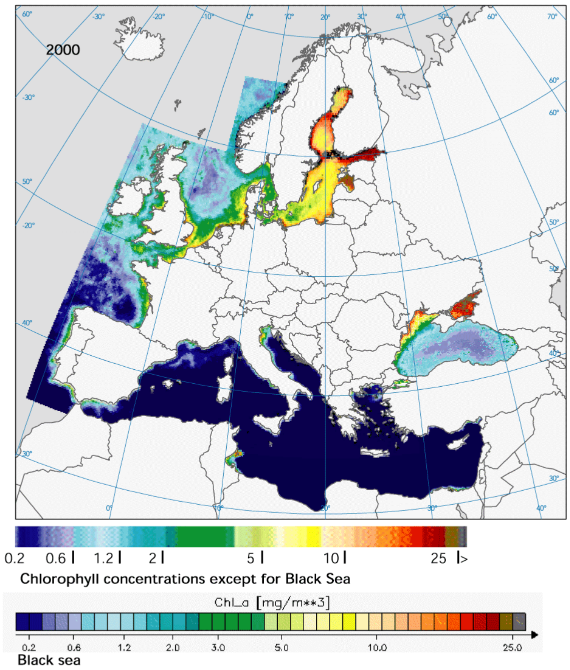
Key message
☺ Generally no trend is observed in summer surface chlorophyll-a concentrations in the Baltic Sea, Greater North Sea or Greek coastal waters.

Figure 4.27 Trends in average summer chlorophyll a concentrations in Europe's Seas



Notes: Number of stations in brackets.
Baltic Sea: Denmark, Finland, Lithuania, Sweden
North Sea: Belgium, Denmark, Netherlands, Norway, Sweden
Mediterranean Sea: Greece
Results of trend analyses applied to time series for the period 1985-2000 (stations with at least 3 years data in the period 1995-2000 and at least 5 years in total) are shown with a bar chart for each sea region.
Source: Data from HELCOM, OSPAR and EEA member countries.

Map 4.5 **Mean spring summer concentrations of chlorophyll like pigments in European Seas determined from satellite observations**



Note. Mean spring-summer (April-September) concentrations of chlorophyll-like pigments in European seas as determined from SeaWiFS satellite observations. The concentration scale (µg/l) is valid only for oceanic waters and overestimate to a large and variable degree the chlorophyll concentrations in coastal seas and the entire Baltic Sea as a result of high concentrations of coloured dissolved organic material (gelbstoff).

Source: Joint Research Centre, compiled by EEA

Policy question 3: *Are we enhancing the status of the aquatic ecosystems and lowering the adverse effects of nutrient pollution?*

Harmful phytoplankton in coastal waters

Key message

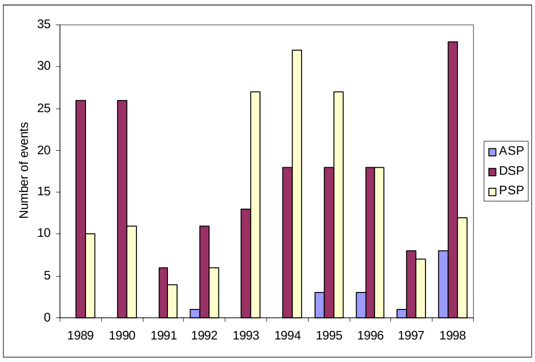
☹ Since the 70's, the harmful algae phenomenon has increased throughout the world. There is no clear trend in shellfish poisoning events in European waters.

Nutrient enrichment from increasing inputs from human activities can lead to modification of the nitrogen, phosphorus and silicon ratios, which could lead to modifications of species composition, particularly enhancing flagellates species, including the main toxic species (*Dinophysis, Alexandrium, Gymnodinium*). Among the numerous (over 6 000) phytoplankton species existing all over the world, several toxic or harmful species have been recorded. Some toxic species produce toxins that are directly toxic to marine fauna, and other produce toxins, which accumulate in shellfish, fish, etc. The latter may then subsequently be transmitted to humans, and through consumption of contaminated seafood become a serious health threat.

For the European waters, over the last ten years, shellfish-poisoning events show fluctuations between years without general trend for diarrhetic shellfish poisoning, and paralytic shellfish poisoning. Amnesic shellfish poisoning occurrences seem to occur more frequently than in the past (Figure 4.28).

Over the 1989 to 1998 period for Europe, amnesic shellfish poisoning events are the less frequent with only five years of occurrence and one peak of more than 5 events (in 1998). Recent indications tend to show that amnesic shellfish poisoning is increasing. Events have been recorded in France in 2000, which was never the case before. Paralytic shellfish poisoning events are regularly observed. Their numbers were particularly high over the 1993-1996 period. Diarrhetic shellfish poisoning is the most common type of poisoning.

Figure 4.28 Shellfish poisoning events in European waters



Notes:
DSP = diarrhetic shellfish poisoning
PSP = paralytic shellfish poisoning
ASP = amnesic shellfish poisoning
Occurrence of harmful algae, which are widely distributed in marine and coastal waters, does not necessary means poisoning events. Understanding of interactions between physical and biological processes leading to harmful blooms presently is an active field of research. In addition to that, monitoring of poisoning events used to be focussed on shellfish production areas.
Sources: ICES-IOC HAEDAT (Harmful Algae Event Data Base)
Data from Denmark, France, Germany, Ireland, The Netherlands, Portugal , Spain, Sweden, UK, Iceland and Norway

Policy question 3: *Are we enhancing the status of the aquatic ecosystems and lowering the adverse effects of nutrient pollution?*

Low oxygen concentrations in bottom layers of marine waters

Key messages

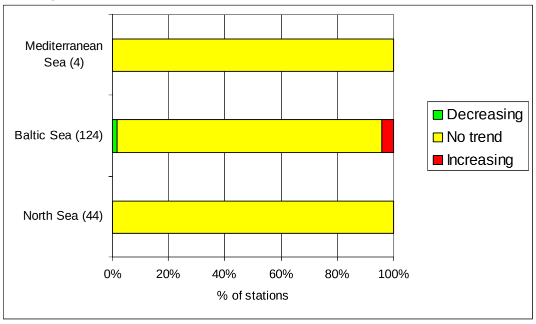
☺ Generally no trend is observed in the frequency of low oxygen concentrations in the Baltic Sea, North Sea and Mediterranean Sea.

☹ Low oxygen concentrations are a problem in specific estuaries with large inputs of nutrients and little mixing of the water column as well as in stratified coastal waters and in the deep troughs of the Baltic Sea and entire Black Sea.

When the oxygen concentration in bottom water is below 2 mg O_2/l the conditions are described as hypoxic and most bottom dwelling organisms die. Most of the organic material in the sediment arises from sedimentation of dead phytoplankton (Olesen and Lundsgaard, 1995). It's degradation rate is dependent on temperature. Consequently, oxygen deficiency is mostly observed in summer and autumn when bottom water temperature is high. The supply of oxygen to the bottom water depends on the hydrographical conditions of the specific area (wind conditions, stratification, advection, tidal mixing, etc.). Marine areas with strong stratification and small advective transport are sensitive to oxygen deficiency.

The coastal waters of the North Sea are generally not impacted by hypoxic conditions due to strong tidal mixing, particularly in the southern part. The deeper parts of the Baltic Sea are characterised by frequent or permanent hypoxic conditions which can be ascribed to the low exchange of bottom waters. The majority of coastal stations are not affected by hypoxia, except for a few fjords and stratified coastal waters that are prone to hypoxia. In the Mediterranean Sea both the Italian and Greek coasts appear to have a low frequency of hypoxia except for the Gulf of Saronikos where hypoxic conditions were observed (>20 %) at 5 stations, 4 of these at depths below 200 m.

Figure 4.29 Trends in the frequency of low oxygen concentrations in bottom waters of Europe's Seas



Notes
Number of stations in brackets.
North Sea: Belgium, Denmark, Norway, Sweden
Baltic Sea: Denmark, Estonia, Finland, Germany, Lithuania, Poland, Sweden
Mediterranean Sea: Greece, Italy
Source: Data from ICES and NRCs contributions to MARINEBASE.
Results of trend analyses applied to time series for the period 1985-2000 (stations with at least 3 years data in the period 1995-2000 and at least 5 years in total) are shown with a bar chart for each sea region.
Source: Data from HELCOM, OSPAR and EEA member countries.

The inner Danish marine waters are frequently impacted by oxygen depletion. In 2002 the oxygen depletion started unusually early and was more extensive than normal (Danish Ministry of the Environment, 2002). This was attributed to the high level of precipitation (increasing nutrient run-off) in January/February, and again in June/July, combined with a long, calm and warm summer period. This provided ideal conditions for phytoplankton growth. Decomposition of the dead algae used up the oxygen in the bottom waters. The oxygen depletion severely affected the benthic invertebrates in many places. In the short term this would have affected demersal fish and diving ducks for which the benthic invertebrates are food resource.

Policy question 4: *How effective are existing policies in reducing loading of nutrients and organic matter?*

Implementation of the Urban Waste Water Treatment Directive

The Urban Waste Water Treatment Directive (91/271/EEC) is an important Community water policy and its aim is to protect the environment from the adverse effects of urban wastewater discharges. The Directive sets minimum standards for the collection, treatment and disposal of wastewater dependent upon the size of the agglomeration, and the type and sensitivity of the receiving waters. The Directive has some important deadlines. The following assessment of the implementation of the directive is based on the Commissions report 2002 on Member States implementation of the Directive.

By 30 June 1993 the Directive had to be transposed into national law. Many Member States were late in transposing the directive, the last being Italy in 1999.

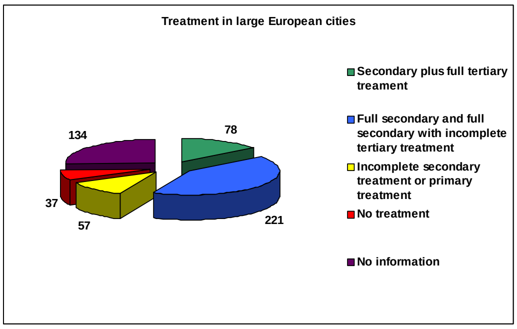
Member States were required to identify sensitive areas at the latest by 31 December 1993. Sensitive areas are surface waters which may become eutrophic if protective action is not taken; drinking waters with nitrate exceeding standards and areas where further treatment is required to comply with other directives (e.g. bathing waters or shellfish waters). Six Member States have decided to apply stringent (tertiary) treatment over all their territory (all sensitive area); nine other Member States have identified certain water bodies in their territory as sensitive area. These areas were identified, with a greater or lesser degree of delay, between 1994 and 1999.

By 31 December 1998 Member States were required to ensure, that wastewater treatment facilities with stringent (tertiary) treatment were available for all agglomerations with a population equivalent greater than 10 000 where the effluent was being discharged into a sensitive area. Major delays in implementing have been found in most Member States. Taking the 3 243 agglomerations in which Member States have decided to provide tertiary treatment out of some 20 000 agglomerations affected by the directive, only Denmark and Austria were in a situation very close to conformity on 31 December 1998 and eight countries were far from conformity. However, most Member States had plans to achieve conformity in these agglomerations over the next few years.

Key messages

- ☹ In 1998, only two EU countries were close to conforming to the requirement of the Directive for their large agglomerations discharging into sensitive areas, and eight countries were far from conformity.
- ☹ Many large cities did not have a sufficient standard of treatment to meet the objectives of the Directive.

Figure 4.30 Levels of urban wastewater treatment in large cities in the EU



Source: DGENV 2002

A large number of the 527 cities with population equivalents of more than 150 000 did not have a sufficient standard of treatment by end of 1998 (Figure 4.30). Thirty-seven had no treatment at all including Brussels, Milan and Porto; while a total of 57 others including Aberdeen, Athens, Barcelona, Dublin, Florence, Liège and Marseille were also discharging a large part of their effluents untreated or had a very clearly insufficient level of treatment in place. The situation is however generally improving and some of these cities made the necessary investment in 1999-2002, or plan to complete work soon.

Policy question 4: *How effective are existing policies in reducing loading of nutrients and organic matter?*

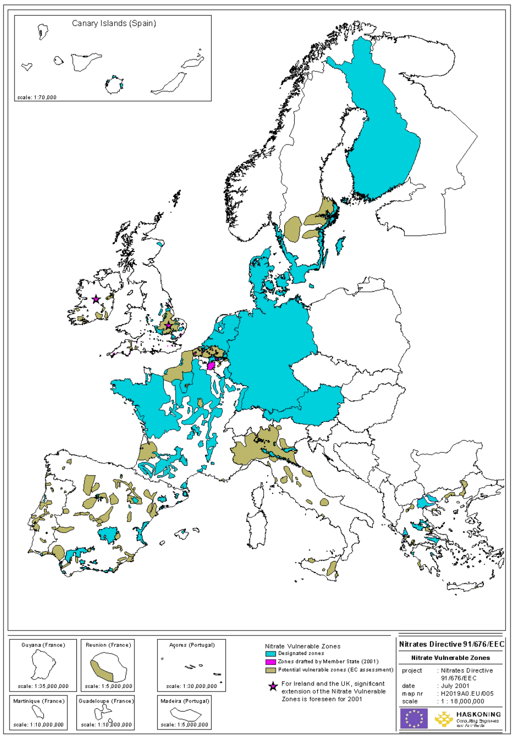
Implementation of the Nitrates Directive

> Key messages
>
> ☺ Considerable progress has been made in most Member States in developing action programmes for nitrate vulnerable zones.
> ☹ However, none of the action plans fully comply with the obligations that are specified in the 'Nitrates Directive'.

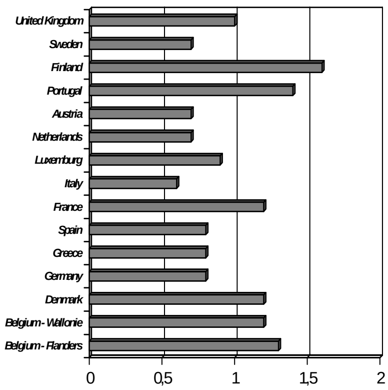
In 1991 the EU Member States adopted the Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources (The 'Nitrates Directive'). This Directive requires Member States to designate nitrate vulnerable zones and to establish action plans for the minimisation of agricultural nitrate leaching in these zones. These plans should cover aspects of agricultural nutrient management and application that are particularly relevant for nitrate leaching. Annexes II and III of the Nitrates Directive spell out the main types of actions to be taken by the Member States. These include measures such as periods of prohibition of fertiliser application, restrictions for application of manure on sloped or frozen soils, manure storage, crop rotation, buffer strips etc.

Implementation of the Nitrates Directive across Europe has been generally extremely poor with all but two countries (Denmark and Sweden) having infringement proceedings brought against them at some stage since the Directive came into force in 1991. However considerable progress has been made in all Member States in developing action programmes for nitrate vulnerable zones during the first action plan period (except Ireland which until 2001 had not designated any Nitrate Vulnerable Zones). The total area of Nitrate Vulnerable Zones in June 2001 covered currently 38 % of the EU 15 area. Based on the assessment of the European Commission, this area should increase to at least 46 %. Designation and revision of nitrate vulnerable zones is still in progress in Ireland, Greece, Belgium and UK. However, none of the action plans fully comply with the obligations that are specified in the Directive. Only five countries reach a mean score higher than 1 (partly satisfactory). This shows that considerable further action is required to ensure effective protection of surface and ground waters from agricultural nitrate pollution in a clear majority of EU Member States.

Map 4.6 Nitrate Vulnerable Zones and related Action Plans



Notes:
Adequacy of national Action Plans under the EU Nitrates Directive.
Mean compliance score for 12 aspects of the Action Plans.
0 = unsatisfactory
1 = partly satisfactory
2 = fully satisfactory



Source EC (2002)

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