**Key message**

ifen BOD levels generally decreased in the 1990’s in EEA countries. This decrease was most obvious in the Accession countries. The levels of BOD are lower in the EU countries than in the Accession countries reflecting better waste water treatment in the EU countries.

ifen In the 1990’s, ammonium levels declined by about 40% in EU rivers and by about 60% in the rivers of the Accession countries.

**Figure 1: Annual median concentrations of a) BOD and b)ammonium in EEA rivers.**

**a) BOD**

![BOD Concentrations Graph]

Notes: Total number of stations in brackets. Number of stations from each country shown below:

<table>
<thead>
<tr>
<th>EU</th>
<th>no of stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>DK</td>
<td>4</td>
</tr>
<tr>
<td>FR</td>
<td>148</td>
</tr>
<tr>
<td>UK</td>
<td>103</td>
</tr>
<tr>
<td>Total</td>
<td>255</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACC</th>
<th>no of stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>BG</td>
<td>45</td>
</tr>
<tr>
<td>HU</td>
<td>84</td>
</tr>
<tr>
<td>SI</td>
<td>21</td>
</tr>
<tr>
<td>SK</td>
<td>41</td>
</tr>
<tr>
<td>Total</td>
<td>191</td>
</tr>
</tbody>
</table>

Source: Based on EUROWATERNET data
Results and assessment

Policy context

The Urban Waste Water Treatment Directive (91/71/EEC) aims to decrease organic pollution from this source and analysing temporal trends in BOD and ammonium concentrations helps to assess the success of this legislation. BOD is one of the main parameters in the Directive where the limit for net discharges of BOD is 25 mg/l. This policy aims at improving the quality of water and this indicator illustrates how far the policy has achieved this.

The Water Framework Directive requires monitoring and assessment of physico-chemical quality elements of water bodies. Under this oxygenation conditions and nutrient conditions must be monitored, and BOD and ammonium are key parameters for this.

Environmental context

BOD is a key indicator of the oxygenation status of water bodies. BOD is the oxygen demand brought about by organisms in water and sediment acting on oxidisable organic matter. In many European countries either the BOD5 or BOD7 test is used. In these tests the dissolved oxygen in the sample is measured and then the sample is incubated for 5 days or 7 days, respectively.
The dissolved oxygen is then measured again and the difference between the initial and final dissolved oxygen is the BOD5 or BOD7.

High BOD is usually a result of organic pollution, caused by discharges from wastewater treatment plants, industrial effluents and agricultural run-off. High BOD has several effects on the aquatic environment including reducing river water chemical and biological quality, reducing biodiversity of aquatic communities and reducing the microbiological quality of waters. Decreases in BOD in rivers illustrates general improvements in river water quality in terms of the chemical and microbiological properties of the river.

Ammonium concentrations are normally raised as a result of organic pollution, caused by discharges from waste water treatment plants, industrial effluents and agricultural runoff. It 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.

Assessment

There was a decrease in BOD and ammonium concentrations in the EU countries (Figure 1) which is likely to be mainly to do with the implementation of the Urban Waste Water Treatment Directive and hence an increase in the treatment level of wastewater. BOD and ammonium concentrations also declined in the Accession countries probably partly to do with improved waste water treatment but also due to economic reform resulting in a decline in polluting manufacturing industries. However, levels of BOD and ammonium are higher in the accession countries where wastewater treatment is not so advanced. Ammonium concentrations in both EU and Accession countries are still way above background concentrations which are around 15 µg/l (as N).

Sub-indicator: BOD in rivers by country

Key message

☺ BOD levels are declining in most countries with particularly large declines in the Accession countries.

Figure 2: Median of the stations annual average BOD concentrations by country.

Notes: Data are for BOD5 for all stations except for Finland and Estonia which are for BOD7. Number of stations in brackets. Early 1990s = average 1990-1993, mid 1990s = average 1994-1997, late 1990s = average 1998-2000

Sources: Based on EUROWATERNET data collection
Assessment for the sub-indicator

Declines in BOD levels are evident in nearly all of those countries for which data are available. The largest declines were in those countries that had the highest levels at the beginning of the 1990s (i.e. the Accession countries). However, the Accession countries still have the highest concentrations.

Sub-indicator: Ammonium in rivers by country

Key message

Ammonium concentrations are highest in the Eastern European Accession countries and lowest in Northern European countries. However, the Eastern European countries had the greatest declines in levels during the 1990s.

Figure 3: Median of the stations annual average ammonium concentration by country.

Sources: Based on EUROWATERNET data collection

Assessment for the sub-indicator

The decrease in ammonium levels in the EU countries is mainly due to dramatic declines in Germany’s levels. Now all the EU countries for which data are available have median levels below 200 µg N/l.

There have also been dramatic decreases in ammonium levels in some of the accession countries e.g. Bulgaria and Poland. The accession countries have a wide range of median levels with Bulgaria and Poland still above 400 µg N/l but Latvia and Estonia below 100 µg N/l. Levels are generally still highest in the Eastern European Accession countries and lowest in the Northern European countries.
**Data**

Spreadsheet files:
- 18a_18b_18c_BOD_N_P_Amm_2.xls (figure 1)
- 18c_Ammonium_country_years.xls (figure 3)
- 18c_EU_EFTA_TotalAmmonium.xls
- 18c_PHARE_ACC_TotalAmmonium.xls
- 18a_BOD_country_years.xls (figure 2)
- 18a_EU_EFTA_BOD7.xls
- 18a_PHARE_ACC_BOD5.xls
- 18a_PHARE_ACC_BOD7.xls
- 18a_EU_EFTA_BOD5.xls

**Meta data**

**Technical information**

1. Data source: WATERBASE, EEA-ETC/WTR database containing EUROWATERNET data
2. Description of data: Data are for BOD5 or BOD7 (mg O$_2$/l) and NH$_4$ (µg N/l) monitored at representative water monitoring stations i.e. those which reflect the majority of rivers in a region/area with human activities in the catchment consistent with the region’s/area’s activities.
3. Geographical coverage: EU, EFTA and Accession countries but not enough data for some countries to be used in the assessment.
4. Temporal coverage: 1975-2000 but this assessment only used data from 1990 to 2000 as this period had the most consistent dataset in terms of years, numbers of stations and countries covered.
5. Methodology and frequency of data collection: Ongoing data exchange with NFPs. Data collection is annual.
6. Methodology of data manipulation: Data are reported as annual means (plus other statistics) for each station included in EUROWATERNET. The data between stations are highly skewed and hence annual median concentrations are used to summarise the data.

**Qualitative information**

7. Strength and weakness (at data level): The dataset covers more stations and countries across Europe than has previously been available. Currently, detailed information is only available from relatively few western countries and there are less time series data for Southern and Nordic countries.
8. Reliability, accuracy, robustness, uncertainty (at data level): The EUROWATERNET stations are designed to give a representative overview of the status in each country. Data are provided by official national data sources and have had some initial validation. However, there is a large amount of data variability within each strata and within each year which could perhaps be reduced by a more thorough statistical assessment.
9. Overall scoring
Relevancy: 2
Accuracy: 2
Comparability over time: 2
Comparability over space: 2

**Further work required:**

This indicator will be improved as more countries implement EUROWATERNET. There are gaps in river characteristic information from some countries which does not enable stratification by river size. More time series data would improve the dataset as would data from a larger number of stations from each country.