European Environment Agency

Indicator Fact Sheet

(WEU01) Nitrate in groundwater

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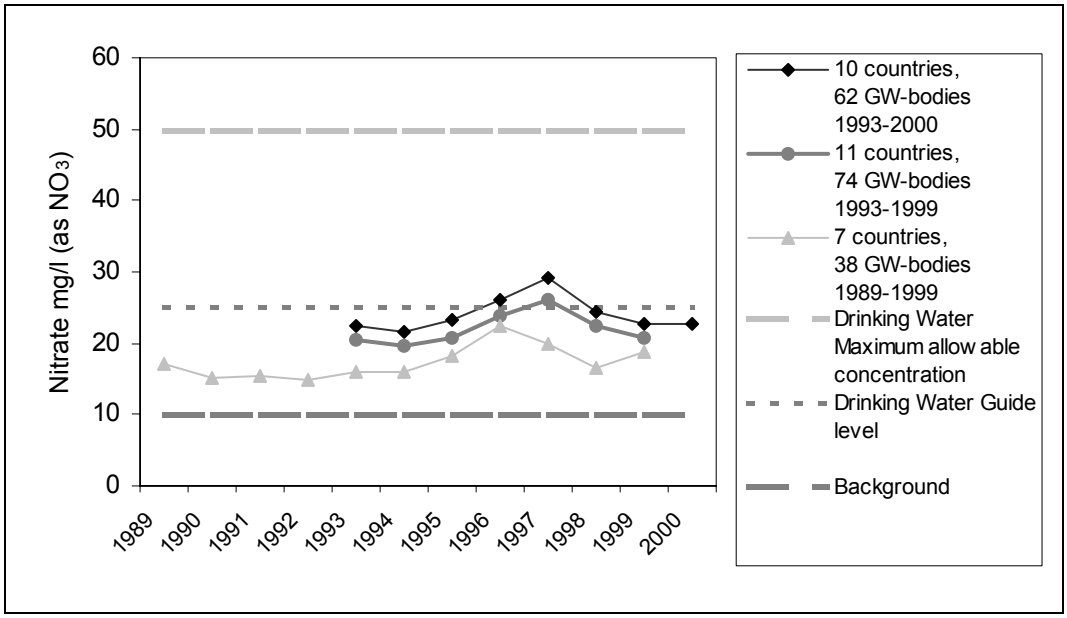
Key message

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

Temporal development of nitrate (arithmetic) mean values in groundwater bodies



Note: The figure compares three 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.

The Drinking Water guide level is laid down in the Drinking Water Directive 80/778/EC. This Directive is repealed with effect from five years after the entry into force of Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption. In the new Drinking Water Directive 98/83/EC a Drinking Water guide level is no longer mentioned.

Each time series consists of consistent data sets with no data gaps. For each time series the annual mean values of sampling sites were aggregated on the level of GW-bodies and, furthermore, these GW-body means were aggregated on European level (arithmetic mean).

Source: EUROWATERNET-Groundwater, 2002.

Results and assessment

Policy relevance:

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 maximum allowable concentration 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 two 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.

Policy context:

The indicator aims to indicate whether the pollution with nitrogen is decreasing or not.

One key approach of the Sixth Environment Action Programme of the European Community 2001-2010 is to "integrate environmental concerns into all relevant policy areas" which could result in a more intense consideration of this issue (e.g. in the Common Agricultural Policy).

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.

Environmental context:

Agriculture is the largest contributor of nitrogen pollution to groundwater since nitrogen fertilisers and manure are used in excessive amounts on arable crops to increase yields and productivity. In the EU mineral fertilisers account for almost 50 % of nitrogen inputs into agricultural soils and manure for 40 % (other inputs are biological fixation and atmospheric deposition) [1]. According to the indicator on the use of fertilisers, nitrogen fertiliser consumption (mineral fertilisers and animal manure) increased until the late 1980s and then started to decline but in recent years it has increased again in the EU and EFTA countries. Nitrogen fertiliser consumption per hectare of arable land is higher in the EU and EFTA countries than in the accession countries .

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.

A further indicator on the nitrogen balance in agricultural soils indicates that there is a large nitrogen surplus in the agricultural soils of EU countries that can potentially pollute groundwaters [7]. Furthermore, a high potential for nitrogen pollution in western Europe results from the combination of high percentage of agricultural land and a high livestock density [6].

Assessment:

Mean nitrate levels in groundwaters in Europe are above background levels (<10 mg/l (as NO_3) (EEA, 2000)) but do not exceed 50 mg/l as NO_3. Elevated mean nitrate concentrations in 1996 and 1997 are mostly caused by single very high values. Several additional information have to be taken into account (see subindicators) for the interpretation of the figures as they may have a strong influence on the quality data provided (e.g. type of GW-bodies and type of monitoring sites).

According to the latest European Commission report [1] there is a high and stagnant level of nitrate concentrations in groundwater. The general trend in nitrate concentrations in groundwater when comparing the first (1992–1994) and second (1996–1998) monitoring exercise is summarised as "stable to increasing". Countries showing an overall increase in nitrate concentrations in groundwater are France and Sweden [1].

It is very difficult to prove a direct context between the application of nitrogen fertiliser in agriculture and the nitrate content in groundwaters as there is often a significant time lag between changes in agricultural practices and changes in nitrate concentrations in groundwater of up to 40 years, depending on the hydrogeological conditions.[4].

The map on nitrate problem areas in EEA (2000) and statements in several State of Environment reports indicate that the provided information might not fully reflect problems with nitrate in groundwater in Europe.

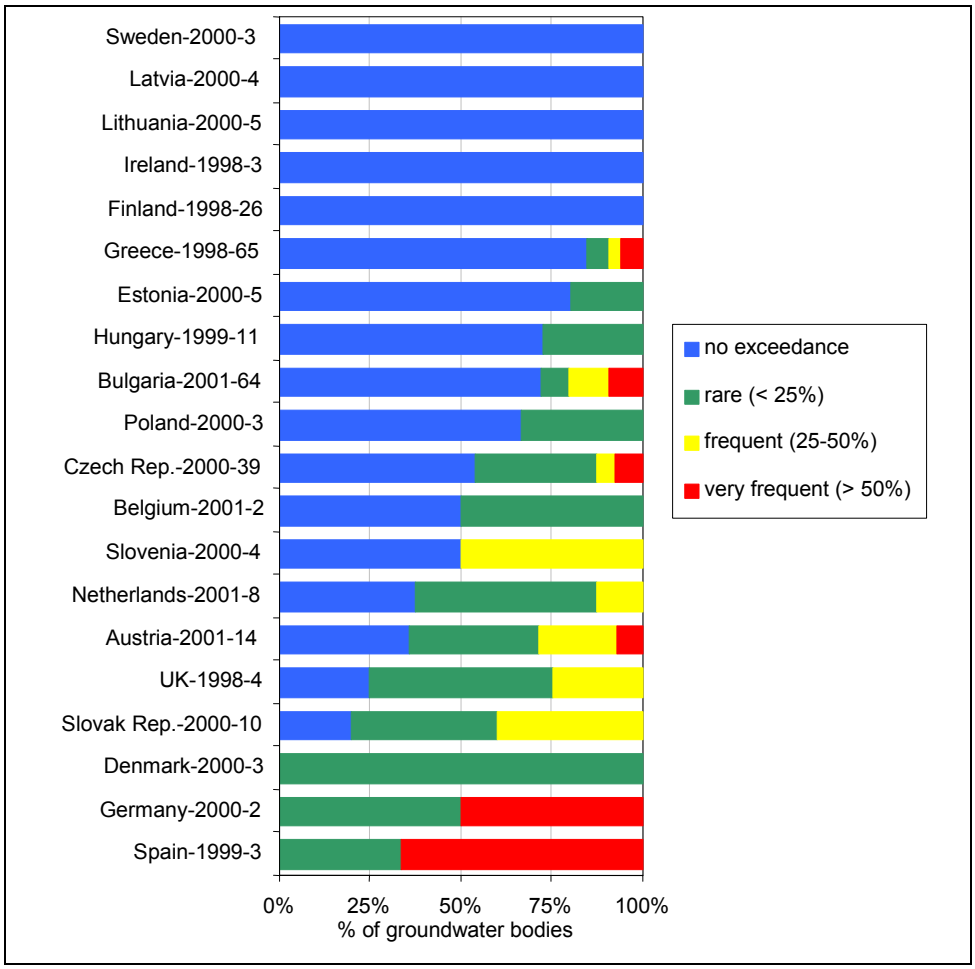
Subindicator 1

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

Key message

● Nitrate drinking water limit values are exceeded in around one-third of the groundwater bodies for which information is currently available.

Statistically significant trends for nitrate in groundwater bodies



Note: The figure is based on the data for the latest year available (given after the country name). The numbers of groundwater bodies per country included in the presentation are given after the year. The four classes represent the percentage of sampling sites within each groundwater body where annual mean nitrate values exceed 50 mg NO_3/litre.

Source: EUROWATERNET-Groundwater, 2002.

Assessment for the sub-indicator

The annual mean nitrate concentration in at least one sampling site in about one third of the groundwater-bodies (included in EUROWATERNET) exceeds 50 mg/l nitrate. Values higher than 50 mg NO_3/l were detected frequently or very frequently in 39 groundwater-bodies (14 %).

According to the latest European Commission report [1] 20 % of EU stations had concentrations in excess of the maximum allowable concentration (50 mg/l as NO_3) and 40 % were in excess of the guide value in the Drinking Water Directive (25 mg/l as NO_3) in 1996–1998. A more favourable situation is to be found in Estonia, where the percentage of shallow wells that exceed the national standard of 45 mg/l of nitrate remains low at around 5 % of the total, which impresses a significant improvement over 1988, where almost 30 % of wells failed to meet the standard [5].

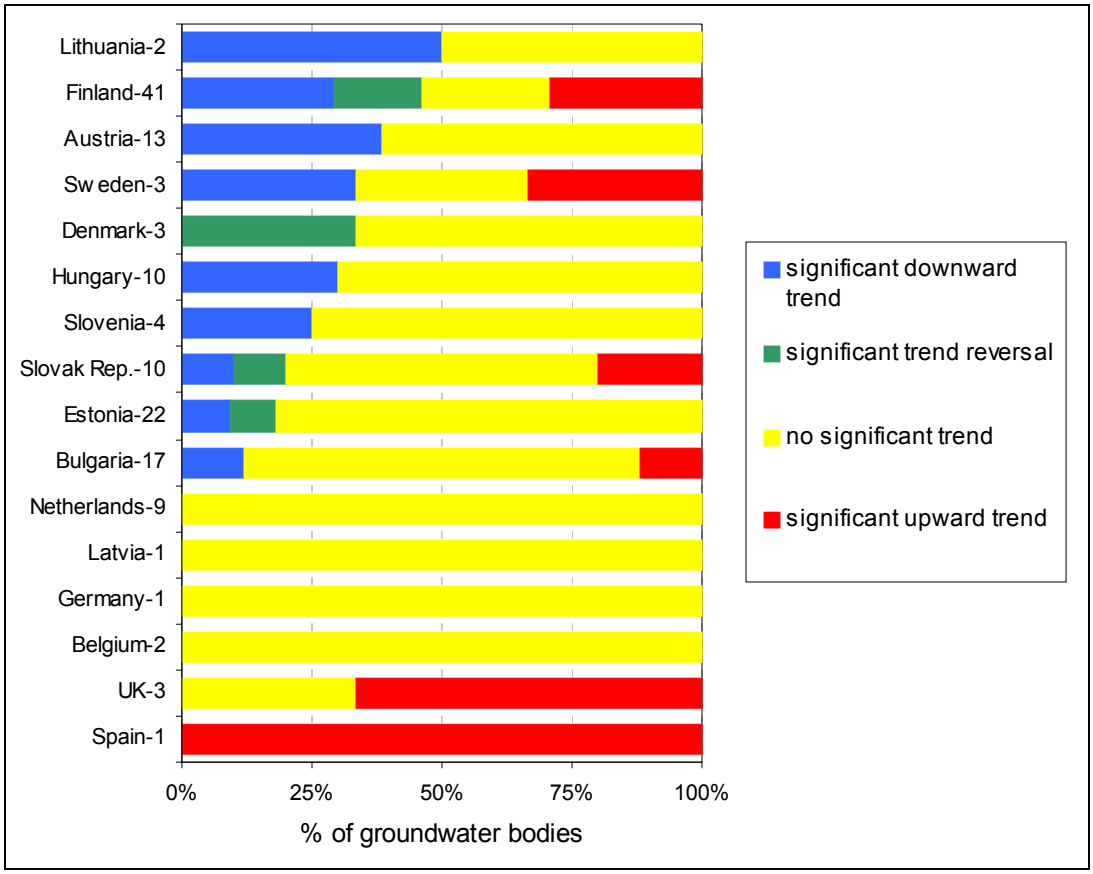
Subindicator 2

Statistically significant trends for nitrate

Key message

😐 The temporal development of nitrate in groundwater demonstrates no substantial improvement. In 27 % out of 142 GW-bodies a statistically significant downward trend or a trend reversal could be proved, for about 59 % of the GW-bodies no improvement could be stated and for 14 % of the GW-bodies even an upward trend was proved.

Statistically significant trends for nitrate in groundwater bodies



Note: The figure is based on the latest years available. The number of assessed groundwater bodies is given after the country name. In general, assessment for time series as long as possible, but minimum /maximum length of time series for trend assessment (LOESS-smoother) = 8 years / 15 years, minimum /maximum length of time series for trend reversal assessment (2-section model) = 14 years / 30 years. Missing of one value within a time series was accepted.

Source: EUROWATERNET-Groundwater, 2002; Algorithm: http://www.wfdgw.net, 2001.

Assessment for the sub-indicator

The results of the trend assessment together with the temporal development of nitrate mean values demonstrated in the main indicator do not allow for an optimistic view. When interpreting trend developments, the often significant time lag between changes in agricultural practices and changes in groundwater quality have to be kept in mind.

Trend assessment was performed by the LOESS smoother, trend reversal was assessed by the 2-section model, both as proposed by Working Group 2.8 of the Common Implementation Strategy of the EC for the Water Framework Directive (http://www.wfdgw.net/). In order to be in line with the WFD the presentation of this indicator will be modified as soon as the specifications are laid down in the Groundwater Directive.

Additional information on the algorithms as well as on the project is available at www.wfdgw.net

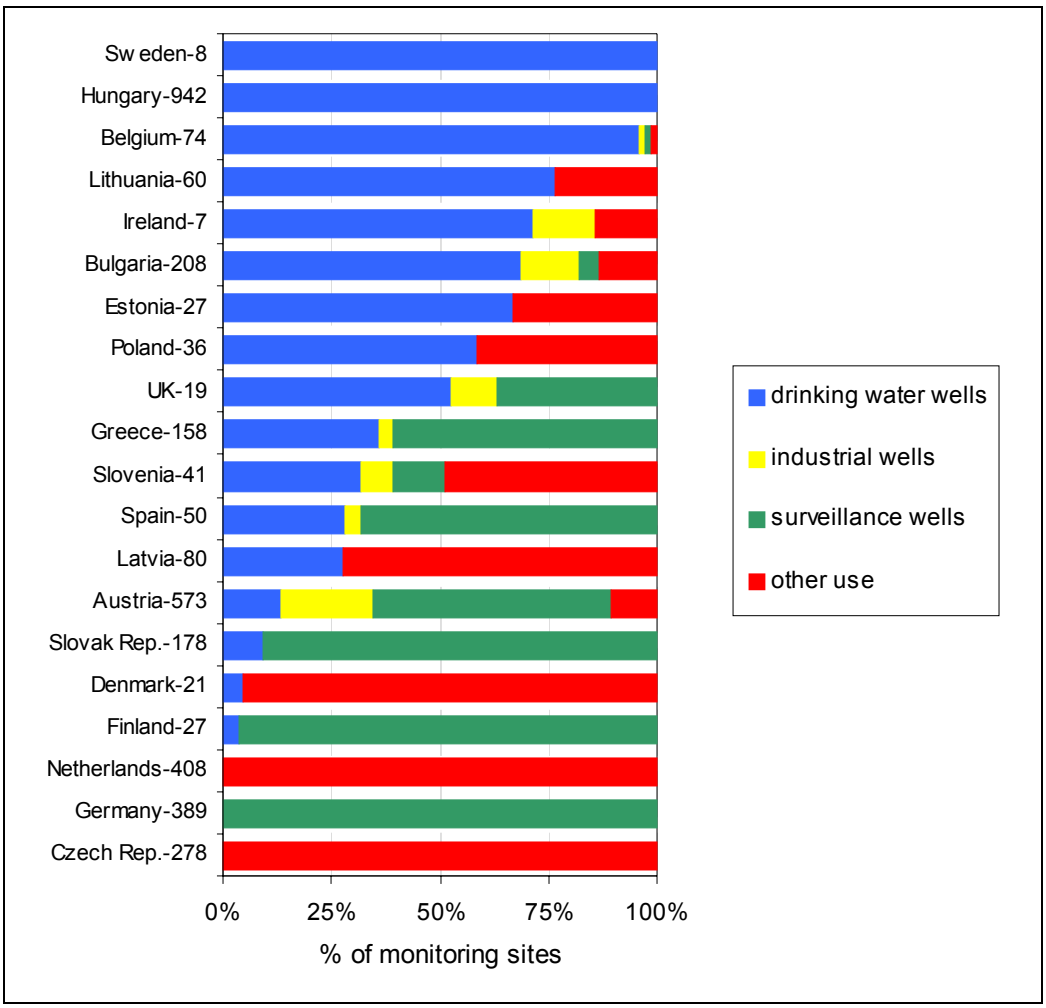
Subindicator 3

Type of monitoring sites for nitrate

Key message

- In several countries sampling sites used for drinking water supply (showing rather good GW-quality) are dominating. The type of use of the sampling site may have a strong influence on the monitored GW-quality, which has to be considered when making comparisons and assessments. The guidelines of EUROWATERNET recommend a "balanced spatial distribution as well as balanced mixture of different types of sampling sites".

Type of monitoring sites for nitrate in groundwater



Note: Share of types of groundwater monitoring sites in %. The number of monitoring sites is given after the country name. Assessment for the latest year available (corresponding to the status assessment of the main indicator).

Source: EUROWATERNET-Groundwater, 2002.

References

EEA (2000): Groundwater quality and quantity in Europe. Environmental assessment report No 3. European Environment Agency. Copenhagen.

EUROWATERNET-Groundwater (2002): working database groundwater.

www.wfdgw.net (2001): The EU Water Framework Directive: Statistical aspects of the identification of groundwater pollution trends, and aggregation of monitoring results.

[1] Implementation of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources. Synthesis from year 2000 Member States reports. Report from the Commission. COM(2002) 407 final. Brussels. 2002.

[2] State of Environment in Latvia. 1996. http://www.vkmc.vdc.lv/soe96/Soil/use%20of%20fertilisers

[3] Trends in Fertiliser consumption. EEA data service. http://dataservice.eea.eu.int/dataservice/viewdata/viewpvt.asp?id=184&i=1&res=3

[4] German Environmental Report 2002. http://www.bmu.de/english/download/files/umweltbericht_engl_2002.pdf

[5] State of Environment in Estonia. 2000. http://nfp-ee.eionet.eu.int/SoE/index_en.htm

[6]: Indicator factsheet 02 - Numbers of livestock

[7]: Indicator factsheet 05 - Nitrogen balance in agricultural soils

Data

Spreadsheet files

Main indicator:NO3_main_temporal.xls

Subindicators: NO3_sub1_status.xls NO3_sub2_trends.xls, NO3_sub3_site-type.xls, NO3_sub4_body-size.xls, EWN_sub5_body-size-all.xls, EWN_sub6_body-type-all.xls

Meta data

Technical information

1. *Data source:* data collection for EUROWATERNET-Groundwater in 2001.
2. *Description of data:* for comparisons at the country level: % of GW-bodies or % of sampling sites. For comparison of time series: mg nitrate per litre
3. *Geographical coverage:* EEA
4. *Temporal coverage:* Most recent year: 1998–2001. Temporal development: 1989–2000. Trend /-reversal assessment: 1967–2001
5. *Methodology and frequency of data collection:* annual data collection through EUROWATERNET
6. *Methodology of data manipulation, including making 'early estimates':* raw data have been aggregated on sampling site level (arithmetic mean), further aggregated on GW-body level (arithmetic mean) further aggregated on EEA level (arithmetic mean). Values below the limit of quantification were treated as 0. *Algorithm for trend/reversal assessment* can be found in: www.wfdgw.net

Quality information

7. *Strength and weakness (at data level):* Strength: for some countries raw data as well as information on the sampling sites are available. Weakness: due to different sampling philosophy data might not be directly comparable. Large geographical data gaps.
8. *Reliability, accuracy, robustness, uncertainty (at data level):* Data situation improved, temporal developments could have been performed due to increasing number of time series

within a given time window. Several (very high) raw data might be corrected in future, but this will not change the interpretation of the overall situation.

9. Overall scoring (give 1 to 3 points: 1=no major problems, 3=major reservations):

Relevancy: 1

Accuracy: 2

Comparability over time: 2

Comparability over space: 2

Further work required

Countries should be motivated to provide data in order to close geographical data gaps. Countries should improve the completeness of the time series (filling gaps) and the completeness of the national coverage. Further validation and checking is the responsibility of the country and might lead to improved time series of nitrate in groundwater.