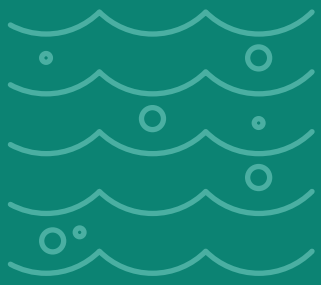
European Environment Agency

8th Environment Action Programme

Nitrate in groundwater



8TH EAP HEADLINE INDICATOR, 2024

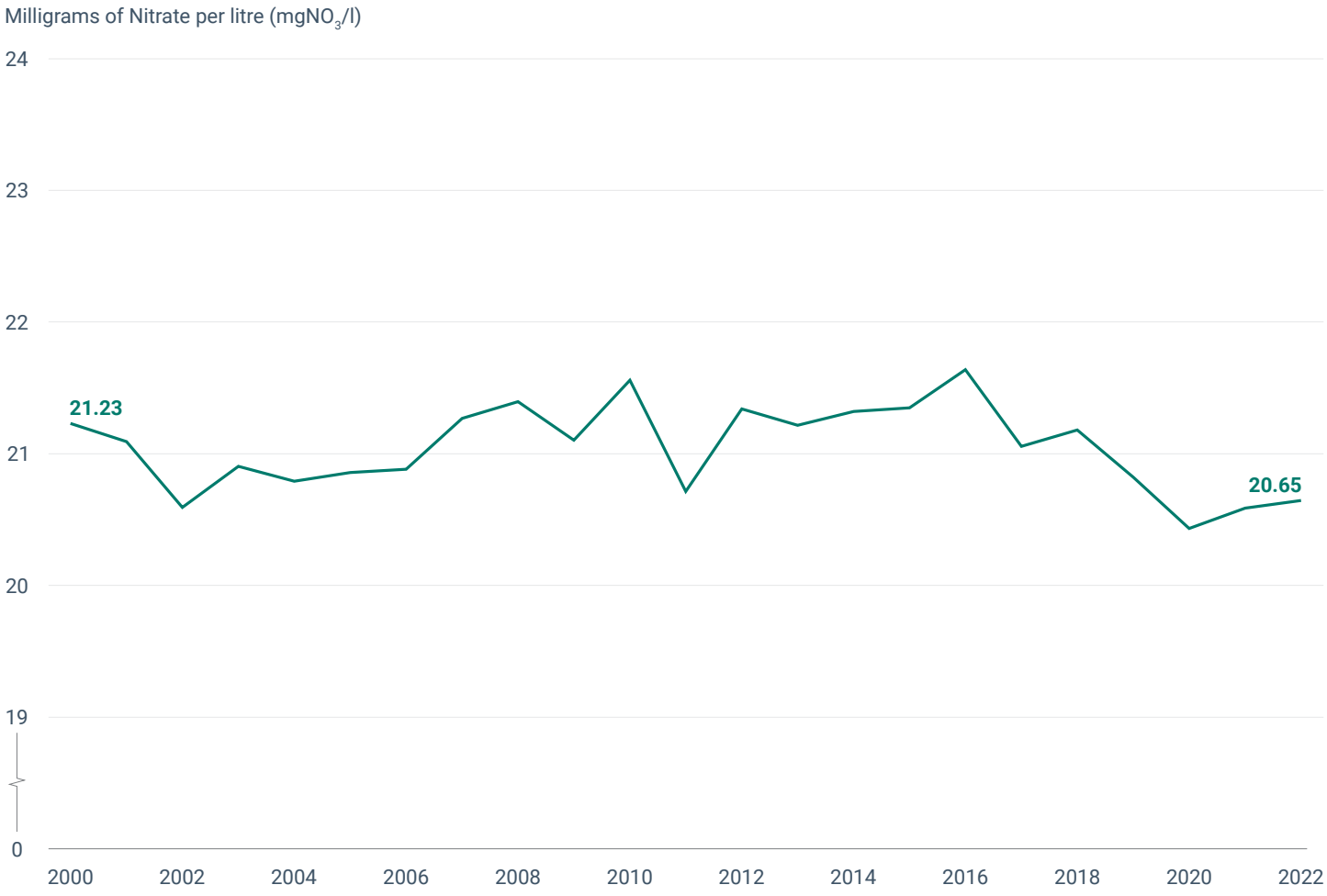
European Environment Agency

Nitrate in groundwater in Europe

Published 12 Dec 2024

Despite legislation addressing nutrient pollution, the average nitrate concentration in European Union groundwaters did not change significantly from 2000 to 2022. The number of groundwater monitoring stations with nitrate concentrations greater than 50mg/l also remains unchanged. Results from a high ambition model scenario show that potential nutrient load reductions are substantial, but still below the 2030 target. Currently, it remains unlikely that the trend is sufficient to achieve EU obligations or the 50% nutrient loss reduction target.

Figure 1. Groundwater nitrate 2000-2022



Nutrients such as nitrogen and phosphorus, not absorbed by plants, are lost and become pollutants when present in excessive amounts. This includes high levels of nitrate (NO_3) in groundwater, which poses a **threat** to

the environment and human health.

Reducing high levels of nitrate in groundwater has been a target of EU policy since the adoption of the Nitrates Directive. Mineral fertilisers and livestock manure are the **main sources** of nitrate concentrations in EU groundwaters. An estimated 80% of the nitrogen discharge to the aquatic environment stems from agriculture and large amounts of nutrients lost to surface- and groundwaters extends to the sea. Around 30% of surface water and 80% of marine waters monitored under the Nitrates Directive have been assessed as eutrophic[1][2][3][4].

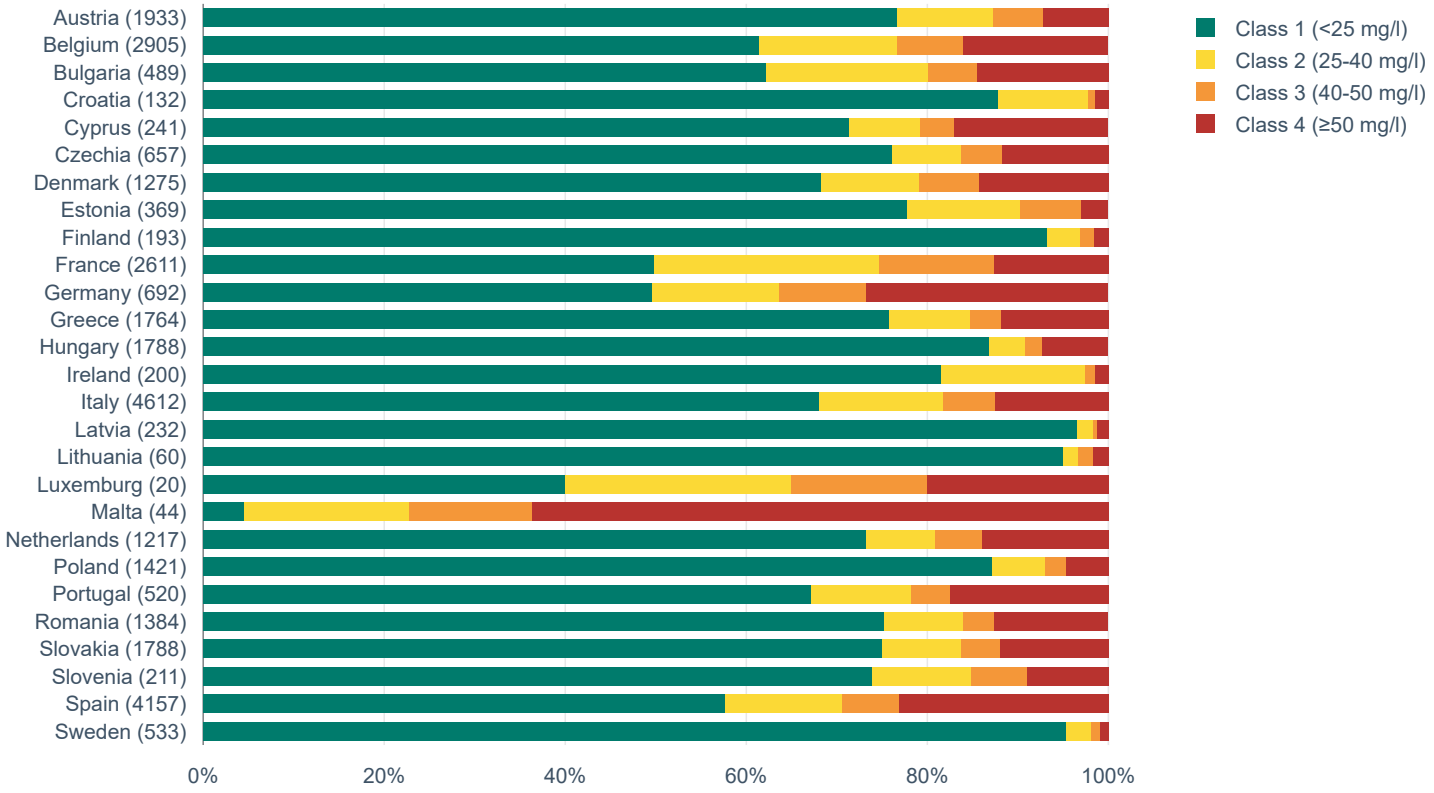
Several directives address nitrogen losses to the environment[1][5][6][7][8] . The Groundwater Directive and the Drinking Water Directive set the maximum **allowable concentration** for nitrate at 50mgNO_3/l in order to protect human health and water resources.

The Zero Pollution Action Plan, Biodiversity Strategy, and Farm to Fork Strategy are initiatives of the European Green Deal. The Deal aims for the EU to **reduce nutrient losses** to the environment by 50%, by 2030. The reduction could lower groundwater nitrate concentrations and decrease the number of monitoring stations with nitrate concentrations above 50mg/l, compared to the reference period 2012-2015[9][10].

Despite legislation addressing nutrient pollution, the average nitrate (NO_3) concentration in EU groundwaters monitored did not change significantly from 2000 to 2022, oscillating around 21mgNO_3/l. Additionally, the Nitrates Directive reporting data over the period 2016-2019 shows 14.1% of groundwater monitoring stations **exceeded** the maximum allowable concentration of 50mgNO_3/l. This is slightly higher than the observed 13.2% from the reporting period of 2012-2015.

An analysis from the Joint Research Centre modelled impacts in a high ambition scenario of improvements in domestic wastewater treatment and reduction of nutrient emissions to air. It used measures under the CAP 2023-2027 needed to achieve the Biodiversity and Farm to Fork strategy targets. The measures, where CAP measures are relevant for groundwater, could in combination, reduce the nutrient load in European seas by 30% for nitrogen and 20% for phosphorus by 2030[11]. While these potential reductions would be substantial, they are still **below the target** of 50% reduction overall in nutrient losses.

Figure 2. Nitrate in Groundwater - Nitrates Directive reporting period 7 (2016-2019)



EU Member States report groundwater nitrate concentrations under the Nitrates Directive. At country level, nitrate concentrations in groundwater monitoring stations for the period 2016-2019 are distributed into four **classes** (Figure 2). Class 1 represents monitoring stations where concentrations are below 25mg/l. At the other end of the scale, class 4 shows the share of stations that exceed the 50mgNO_3/l maximum allowable concentration.

All 27 EU member countries had some groundwaters with **reported** nitrate concentrations above the maximum allowable concentration of 50mgNO_3/l (class 4). The seven countries with more than 15% of their groundwater monitoring stations exceeding this maximum level were Belgium, Cyprus, Germany, Luxemburg, Malta, Portugal, and Spain. In contrast, the seven countries with more than 80% of groundwater monitoring stations below 25mg/l (class 1) were Croatia, Finland, Hungary, Ireland, Latvia, Poland and Sweden.

Supporting information

Definition

This indicator shows concentrations of nitrate in groundwater bodies. The indicator can be used to illustrate geographical variations in current concentrations and temporal trends. Large inputs of nitrogen to water bodies from urban areas, industry, and agricultural areas, can have negative impacts on the use of water for human consumption and other purposes.

Methodology

This indicator uses data reported under two different obligations. For the time series of average concentrations in figure 1 data from WISE SoE - Water quality (WISE-6) reporting obligation are used used

(published in Waterbase – Water Quality ICM). For the country level assessment in figure 2 data from the Nitrates Directive reporting obligation are used.

For the time series in figure 1, annual mean concentrations are used as a basis in the analyses. Unless the country reports aggregated data, the aggregation to annual mean concentrations is done by the EEA. Automatic quality control procedures are applied both to the disaggregated and aggregated data, excluding data failing the tests from further analysis. In addition, a semi-manual procedure is applied, focusing on suspicious values having a major impact on the country time series and on the most recently reported data. This comprises:

- Outliers;
- Consecutive values deviating strongly from the rest of the time series;
- Whole time series deviating strongly in level compared to other time series for that country and determinant;
- Where values for a specific year are consistently much higher or lower than the remaining values for that country and determinant.

Such values are removed from the analysis and checked with the country. For time series analyses, only complete series after inter/extrapolation are used. This is to ensure that the aggregated time series are consistent, i.e. include the same sites throughout.

Inter/extrapolations of gaps up to three years are allowed, i.e. to increase the number of available time series. At the beginning or end of the data series, missing values are replaced by the first or last value of the original data series, respectively. In the middle of the data series, missing values are linearly interpolated. The selected time series are aggregated to country and European level by averaging across all sites for each year.

For analysis of the present state on country level (figure 2), data reported under the Nitrates Directive[1] for reporting period 2016-2019 are used, where data on monitoring station level are collected for each reporting period (four year period) and include characteristics on the water monitoring stations and values for the concentrations of NO_3 for each station. The data is summarised by country and by concentration classes. This information can also be viewed in the JRC exploratory dashboard for reporting period seven. While 2016-2019 is the last period for which there are consolidated data available at EU level, Member States are currently in the process of reporting data for 2020-2023.

Policy/environmental relevance

The quality of freshwater, with respect to nutrient concentrations, is an objective of several directives: The Nitrates Directive[1], aimed at reducing nitrate pollution from agricultural land; the Urban Waste Water Treatment Directive[5], aimed at reducing pollution from sewage treatment works and certain industries; the Industrial Emissions Directive[6], aimed at reducing emissions from industry; the Water Framework Directive[7], which requires the achievement of good ecological status; the Groundwater Directive[12] on the protection of groundwater against pollution and deterioration. The Water Framework Directive also requires the reversal of significant and sustained upward trends in the concentrations of pollutants. Based on the Drinking Water Directive[13], the Nitrates Directive and the Groundwater Directive under the Water Framework Directive, set the maximum allowable concentration for nitrate at 50mg NO_3/l. This is to eliminate the need for expensive water treatment because it has been shown that drinking water in excess of the nitrate limit can result in adverse health effects [3].

Reducing nutrient losses by 50% by 2030 is an important aspect of the European Green Deal[14] initiatives: 'Farm to Fork' Strategy; Biodiversity strategy; Zero pollution action plan[15][16][17]. The Common Agricultural Policy[18][19] (CAP) is a key tool in this respect. The assessment of the 50% target is set out in the Annex to the Recommendations for the CAP Strategic Plans[10] and is evaluated in the context of the Zero Pollution Monitoring Assessment[20] published on 8 December 2022.

The 8th Environment Action Programme[9] supports the objectives of the European Green Deal[14] and forms the basis for the EU to achieve the Sustainable Development Goals of the United Nations.

The 'nitrate in groundwater indicator' is a headline indicator for monitoring progress towards the 8th Environment Action Programme (8th EAP). It mainly contributes to monitoring aspects of the 8th EAP priority objective Article 2.2.d that shall be met by 2030: 'pursuing zero pollution, including in relation to harmful chemicals, in order to achieve a toxic-free environment, including for air, water and soil, as well as in relation to light and noise pollution, and protecting the health and wellbeing of people, animals and ecosystems from environment-related risks and negative impacts'. The European Commission's Communication on the 8th EAP monitoring framework[9] specifies that this indicator should monitor progress towards reducing nutrient losses by at least 50% in safe groundwater resources by 2030.

Accuracy and uncertainties

The indicator is meant to give a representative overview of nitrate conditions in the groundwaters of the European Union. This means it should reflect the variability in conditions over space and time. Countries are asked to provide data on groundwater bodies according to specified criteria.

The Waterbase - Water Quality ICM data for groundwater include almost all countries within the EU, while the Nitrates Directive data includes all EU countries. It is assumed that the data from each country represents the variability in space in their country. Likewise, it is assumed that the sampling frequency is sufficiently high to reflect variability in time. In practice, for Waterbase data, the representativeness will vary between countries, while for the Nitrates Directive data the coverage is more complete but reported at lower frequency.

Annual updates of Waterbase - Water Quality ICM data means that, due to changes in the database, the derived results of the assessment may vary in comparison to previous assessments. Database changes include changes in the QC procedure that excludes or re-includes individual sites or samples and retroactive reporting of data for past periods - which may re-introduce lost time series that were not used in the recent indicator assessments. Through communication with the reporting countries, the quality of the database can be, and incrementally is, further improved.

Data sources and providers

- Nitrates Directive reporting period 7 (2016-2019)(direct link to the dataset is not available), European Environment Agency (EEA)
- Waterbase - Water Quality ICM, European Environment Agency (EEA)

Metadata

DPSIR

State

Topics

 # Water # Agriculture and food

Tags

 # 8th EAP # WAT004 # Freshwater quality # Groundwater # Nitrates

Temporal coverage

2000-2022

Geographic coverage

Austria
Belgium
Bulgaria
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Luxembourg
Malta
Netherlands
Poland
Portugal
Romania
Slovakia
Slovenia
Spain
Sweden

Typology

Descriptive indicator (Type A - What is happening to the environment and to humans?)

UN SDGs

SDG6: Clean water and sanitation

Unit of measure

FIG1: the concentration of nitrate in groundwater is expressed as milligrams of nitrate per litre ($mgNO_3/l$)

FIG2: percentage

Frequency of dissemination

Once a year

References and footnotes

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