

C-11: Nutrients in freshwater

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1) General description

1.1) *Brief definition*

Concentrations of phosphates and nitrates in rivers, total phosphorus and nitrates in lakes and nitrates in groundwater.

1.2) *Units of measurement*

The concentration of phosphates and total phosphorus is expressed as mg of P/litre the concentration of nitrates is expressed as mg of NO₃/litre.

1.3) *Context*

Relation to other indicators from the Guidelines - This indicator relates to indicators "C-10: Biochemical oxygen demand and concentration of ammonium in rivers" and "C-12: Nutrients in coastal seawaters".

2) Relevance for environmental policy

2.1) *Purpose*

The indicator provides a measure of the state of freshwater (rivers, lakes and groundwater) in terms of nutrient concentration.

2.2) *Issue*

Large inputs of nutrients to freshwater bodies from urban, industrial and agricultural point and fugitive sources can lead to eutrophication of water bodies. This causes ecological changes that can result in a loss of plant and fish species (reduction in ecological status) and have negative impacts on the use of water from these water bodies for human consumption and other purposes. The indicator can be used to illustrate current geographical variations in nutrient concentrations and long-term trends.

2.3) International agreements and targets

a) Regional level

The ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes and its Protocol on Water and Health refer to reduction of emissions of biogenic substances by industrial, household and diffuse (fugitive) sources.

b) Subregional level

In the EU the environmental quality of surface waters with respect to eutrophication and nutrient concentrations is an objective of several documents:

- Directive 2000/60/EC of the European Parliament and the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive),
- The Drinking Water Directive (98/83/EC) establishes a maximum allowable concentration for NO₃ of 50 mg/l.
- The Nitrates Directive (91/676/EEC) requires the identification of groundwater sites/bodies where the annual average NO₃ concentration exceeds or could exceed 50 mg/l.
- The Urban Waste Water Treatment Directive (91/271/EEC) aims to decrease organic pollution and pollution by nutrients.

An OECD report of 1980 defines lakes as eutrophic when the annual concentration of phosphorus exceeds 35 mg P/l.

3) Methodology and guidelines

3.1) Data collection and calculations

A programme for monitoring nutrients in freshwater bodies should be structured taking into account the spatial and temporal dynamics of these ingredients. The number of surveillance points and their location should enable collection of information on the background content of nitrates and phosphates (conditioned by the natural process of decomposition of organic matter) for the main morphological types of watercourses. The values of this indicator are subject to anthropogenic activities resulting from spot and diffuse sources.

Time parameters should correspond to hydrological phases, while the frequency of sampling should reflect the need for authentic information. Efforts should be made to ensure methodological and metrological uniformity in surveillance and data processing; microbiological and chemical analytical work should be conducted by accredited laboratories with QA/QC systems.

The values for concentrations of phosphates and nitrates should be provided aggregated per monitoring station. Data for each station should be recorded separately. The type of

sampling sites as well as the monitoring frequency should be also recorded. Furthermore, the highest measured value per station (maximum), the lowest measured value (minimum), the arithmetic mean of all measured values, and the standard deviation for all measures should be calculated. When providing aggregated data as mean values, sample concentrations below the limits of quantification must be replaced with a value equivalent to half the limit of quantification.

3.2) Internationally agreed methodologies and standards

General rules for reporting are presented in the International Recommendations for Water Statistics (IRWS), United Nations 2012. The concentration of NO₃ is determined using the ISO 7890-3:1988 method, based on spectrometric measurement of the compound resulting from the reaction of nitrate with sulfosalicylic acid and its subsequent treatment with alkali. Concentrations of P_{tot} are determined using the ISO 6878:2004 method, which is in compliance with the corresponding method used by countries of South-Eastern and Eastern Europe, Caucasus and Central Asia.

4) Data sources and reporting

Countries of South-Eastern and Eastern Europe, Caucasus and Central Asia have departmental and, in some cases, national databases on the indicator. In some countries, databases include the results of analysis of nutrients concentrations in surface water bodies for several decades. Data in these countries are published in annual surface water quality reports. Statistical agencies report data to the UNSD Environment Statistics Database.

5) References at the international level

- Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment
- Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources
- Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

(Water Framework Directive): http://ec.europa.eu/environment/water/water-framework/index_en.html

- Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council
- Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)
- ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992): <http://www.unece.org/fileadmin/DAM/env/water/pdf/watercon.pdf>; amendment 2003: <http://www.unece.org/fileadmin/DAM/env/documents/2004/wat/ece.mp.wat.14.e.pdf>
- Environmental Indicator Report 2012, EEA 2012
- European Commission – Water Policy: http://ec.europa.eu/environment/water/index_en.htm
- European Environment Agency (EEA): <http://www.eea.europa.eu/themes/water>
- Europe's Environment, The 4th Assessment, EEA 2007
- Eurostat: <http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators>
- GEMS/WATER Operational Guide, 3rd ed. (WHO, 1992)
- Global water information system of the Food and Agriculture Organization (AQUASTAT): http://www.fao.org/ag/agl/aglw/aquastat/water_res/waterres_tab.htm
- International Recommendations for Water Statistics (IRWS): <http://unstats.un.org/unsd/envaccounting/irws/irwswebversion.pdf>
- International Organization for Standardization (ISO): <http://www.iso.org>
- ISO Water Quality – determination of BOD after five days, ISO 5815, (1989)

- Protocol on Water and Health to the ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes: <http://www.unece.org/fileadmin/DAM/env/documents/2000/wat/mp.wat.2000.1.e.pdf>
- Standard Methods for the Examination of Water and Wastewater, 19th ed. (American Public Human Health Association, 1992)
- The European Environment-State and Outlook 2010: Synthesis, EEA 2010
- The Protocol on Water and Health: Guidelines on the Setting of Targets, Evaluation of Progress and Reporting, ECE/WHO 2010: http://www.unece.org/env/water/publications/documents/guidelines_target_setting.pdf
- United Nations Statistics Division (UNSD): <http://unstats.un.org/unsd/environment/>
- United Nations Statistics Division (UNSD)/United Nations Environment Programme (UNEP) Questionnaire on Environment Statistics (2013): <http://unstats.un.org/unsd/environment/questionnaire2013.html>
- United States Environmental Protection Agency (EPA): <http://water.epa.gov/type/rsl/monitoring/vms56.cfm>
- World Health Organization (WHO): <http://www.euro.who.int/en/home>
- World Meteorological Organization (WMO): www.wmo.ch