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WATER INDICATORS[1]

SUMMARY

This document presents the descriptions of water indicators for the guidelines on the application of environmental indicators for Eastern Europe, Caucasus and Central Asia (EECCA). For technical reasons, the descriptions of other indicators are contained in separate documents, as follows: introduction and climate change (ECE/CEP/AC.10/2006/6), air pollution and the ozone layer (CEP/AC.10/2005/4, annex II), water, land and biodiversity (ECE/CEP/AC.10/2006/8), agriculture and waste (ECE/CEP/AC.10/2006/9), energy and transport (ECE/CEP/AC.10/2006/10). The Working Group is expected to agree on the guidelines and submit them to the Committee on Environmental Policy for adoption.

[1] Prepared by the secretariat on the basis of the outcome of the Workshop on the Application of Environmental Indicators held on 5–6 July 2004 in Chisinau, Republic of Moldova (CEP/AC.10/2005/4) and the decision taken by the Working Group on the matter at its fifth session (CEP/AC.10/2005/2, para. 23).

RENEWABLE FRESHWATER RESOURCES

General description

1. **Brief definition:** The total volume of river run-off and groundwater generated in natural conditions, exclusively by precipitation within the country, and the actual flow of rivers and groundwater coming from neighboring countries.

2. **Unit of measurement:** Million cubic metres/year.

Relevance for environmental policy

3. **Purpose:** The indicator provides a measure of the state of renewable freshwater resources in a country.

4. **Issue:** Renewable freshwater resources have major environmental and economic value. Their distribution varies widely among and within countries. Pressures on freshwater resources are exerted by overexploitation as well as by degradation of environmental quality. Relating resources abstraction to renewal of stocks is a central issue in sustainable freshwater resource management. If a significant share of a country's water comes from transboundary rivers, tensions between countries can arise, especially if water availability in the upstream country is smaller than in the downstream one. EECCA countries are quite interdependent with regard to water resources. Particularly in Central Asia, cooperation between countries sharing rivers such as the Syr Daria and the Amu Daria is crucial for life, economic well-being and political stability. Azerbaijan's reliance on drinking water from the transboundary Kura River is another example.

5. **International agreements and targets:** The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes is an important instrument for the protection freshwater resources and the development of transboundary water cooperation. There are no specific quantitative targets directly related to this indicator. However, the Water Framework Directive (2000/60/EC) requires EU countries to promote sustainable use based on long-term protection of available water resources and to ensure a balance between abstraction and recharge of groundwater, with the aim of achieving "good groundwater status" by 2015.

Methodology and guidelines

6. **Data collection and calculations:** Renewable freshwater (surface and groundwater) resources are replenished by precipitation (less evapotranspiration) falling on a country's territory that ends up as runoff to rivers and recharge to aquifers (internal flow), and by surface waters and groundwater flowing in from other countries (inflow). Climatic, ecological, economic and other limitations on the availability of these resources for abstraction are reflected in the variable "regular freshwater resources 95 per cent of the time". Data on renewable freshwater resources are usually collected at selected hydrological stations and calculated on the basis of

long-term measurements carried out on rivers and lakes as well as in groundwater horizons and countrywide precipitation. The indicator is the major indicator used to define the water balance of a country.

7. **Internationally agreed methodologies and standards:** The United Nations Statistics Division (UNSD)/United Nations Environment Programme (UNEP) Questionnaire on Environment Statistics, coordinated with relevant Organisation for Economic Co-operation and Development (OECD) and Eurostat questionnaires.

Data sources and reporting

8. The UNSD International Environment Statistics Database and the Food and Agriculture Organization (FAO) Aquastat database. In many EECCA countries, information concerning this indicator or a set of indicators defining water uses is published in statistical yearbooks as well as in specialized collections dealing with environmental protection. The information is presented in a more comprehensive format in water cadastre materials.

References at the international level

- Convention on the Protection and Use of Transboundary Watercourses and International Lakes
- Raskin, P., Gleick, P.H., Kirshen, P., Pontius, R. G. Jr. and Strzepek, K. . *Comprehensive Assessment of the Freshwater Resources of the World.* (Stockholm Environmental Institute, 1997) Document prepared for the fifth session of the UN Commission for Sustainable Development (1997)
- Water Framework Directive 2000/60/EC: 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
- http://unece.org/env/europe/monitoring/EnvMonRep/index.html
- http://www.unece.org/env/water/pdf/waterconr.pdf
- http://www.unece.org/env/documents/2000/wat/mp.wat.2000.1.r.pdf
- http://unstats.un.org/unsd/environment/
- http://www.fao.org/ag/agl/aglw/aquastat/water_res/waterres_tab.htm
- http://www.euro.who.int/ehindicators/
- http://europa.eu.int/comm/environment/water/water-framework/index_en.html
- http:/europa.eu.int/comm/eurostat
- http://themes.eea.eu.int/IMS/CSI/
- http://oecd.org/env/

FRESHWATER ABSTRACTION

General description

9. **Brief definition:** The volume of surface and ground freshwater abstracted annually: total, by economic activity, per capita and as a percentage of renewable freshwater resources (water exploitation index, or WEI).

10. **Unit of measurement:** Million cubic metres/year for total and by economic activity, cubic metres/year for per capita and percentage for WEI.

Relevance for environmental policy

11. **Purpose:** The indicator provides a measure of the pressure on the environment in terms of abstraction of freshwater resources. It can reflect the extent of water resource scarcity with increasing competition and conflict between different uses and users.

12. **Issue:** Freshwater resources are of major environmental and economic importance. Pressures on freshwater resources are exerted by overexploitation as well as by degradation of environmental quality. Since water quality is closely linked to water quantity, freshwater abstraction to renewal of stocks is a central issue in sustainable freshwater resource management. The indicator can show to what extent freshwater resources are already used and any need to adjust supply and demand management policy. Changes in the WEI help to analyze how changes in abstraction affect freshwater resources by increasing pressure on them or making them more sustainable.

13. **International agreements and targets:** The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes is an important instrument for the protection and use of freshwater resources. There are no specific quantitative targets related to this indicator. However, the Water Framework Directive (2000/60/EC) requires EU countries to promote sustainable use based on long-term protection of available water resources and ensure a balance between abstraction and recharge of groundwater, with the aim of achieving "good groundwater status" by 2015. Targets are also established via international treaties between countries.

14. The WEI threshold which distinguishes non-stressed regions from stressed ones is around 20 per cent. Severe water stress can occur where the WEI exceeds 40 per cent, indicating strong competition for water but not necessarily enough extraction to trigger frequent water crises.

Methodology and guidelines

15. **Data collection and calculations:** Water is abstracted by the public or private bodies whose main function is to provide water for various uses (the water supply industry). It can also be directly abstracted from rivers, lakes, wells or springs by industries, farmers, households and others for their own use. The indicator incorporates data on abstraction of freshwater, broken down according to the main activity of the water abstractor as defined by the International Standard Industrial Classification of All Economic Activities (ISIC Rev. 3.1). The water abstraction indicator calculations are based on the data on quantity of abstracted water reported by water users to the relevant authorities. The quantity of water abstracted is either measured by

water meters or calculated on the basis of energy consumption for pumps. In some cases it is necessary to apply a calculation method using models for some water users (household and agriculture). The indicator is compiled based on reports submitted by the associations, enterprises and organizations abstracting water from surface and ground sources and having at their disposal technological processes (equipment) enabling measurement of water consumption. Reports are first processed at the regional level and then generalized at the national level. Information about this indicator is published in statistical yearbooks as well as in specialized collections dealing with water issues. More comprehensive information is presented in water cadastre materials. The water exploitation index (WEI) is the ratio of annual total water abstraction to long-term annual average renewable freshwater resources, expressed as a percentage. The WEI provides a good picture at the national level of the pressures on resources in an easily understandable format, and it shows trends over time. Changes in the WEI help to analyze how changes in abstraction affect freshwater resources by increasing pressure on them or making them more sustainable.

16. **Internationally agreed methodologies and standards:** The UNSD/UNEP Questionnaire on Environment Statistics, coordinated with relevant OECD and Eurostat questionnaires.

Data sources and reporting

17. The UNSD International Environment Statistics Database and the FAO Aquastat database. Data are collected from countries' statistical reporting. Many EECCA countries have databases that provide fairly comprehensive time series.

References at the international level

- Convention on the Protection and Use of Transboundary Watercourses and International Lakes.
- *OECD Environmental Data Compendium 2004* (OECD, 2004).
- European Environment Agency. Europe's Environment: the third Assessment. 2003.
- International Standard Industrial Classification of All Economic Activities. United Nations, Series M No.4, Rev.3.
- http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm
- http://www.unece.org/env/water/pdf/waterconr.pdf
- http://www.unece.org/env/documents/2000/wat/mp.wat.2000.1.r.pdf
- http://www.fao.org
- http://unstats.un.org/unsd/environment/
- http://europa.eu.int/comm/environment/water/water-framework/index-en.html
- http:/europa.eu.int/comm/eurostat
- http://themes.eea.eu.int/IMS/CSI/
- http://oecd.org/env/

HOUSEHOLD WATER USE PER CAPITA

General description

18. **Brief definition:** The quantity of water used to cover the household and related utility needs of the population (including enterprise employees), calculated per capita.

19. **Unit of measurement:** Cubic metres/ year per capita (or litres/day per capita).

Relevance for environmental policy

20. **Purpose:** The indicator provides a measure of the pressure on the environment in terms of water abstraction from different water sources.

21. **Issue:** Adequate quantities of water for meeting basic human needs are a prerequisite for life, health and development. The indicator is one of the major ones defining the level of development of water economy services and the degree of water accessibility to cover all household needs of the population. This indicator helps to identify trends in rational water use in a particular location. The indicator of household water consumption differs by location and depends on many environmental and economic factors.

22. **International agreements and targets:** The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

Methodology and guidelines

23. **Data collection and calculations:** Household water use per capita can be calculated based on the metered supply, local surveys or the total amount supplied to a community divided by the number of inhabitants. The indicator is an estimate based on territorial reports submitted by associations, enterprises and organizations supplying households with water. Reports submitted by the organizations and enterprises are first processed at the regional level and then generalized at the national level. In a number of EECCA countries, such processing is done on the basis of annual data reported to state statistical services.

24. **Internationally agreed methodologies and standards**: Methodologies are available in many countries.

Data sources and reporting

25. Data are collected based on statistical reporting by countries. In many EECCA countries, databases of fairly comprehensive time series are available. The World Health Organization (WHO) has been collecting estimates of national average figures from governments as part of its water supply and sanitation monitoring activities.

References at the international level

- Convention on the Protection and Use of Transboundary Watercourses and International Lakes
- Eurostat, *Environment statistics: Pocketbook* (2002)
- AQUASTAT – FAO's global information system on water and agriculture
- http://www.unece.org/env/water/links/link.htm
- http://www.unece.org/env/water/pdf/waterconr.pdf
- http:/europa.eu.int/comm/eurostat
- http://www.fao.org
- http://unstats.un.org/unsd/environment/questionnaire2004.htm/
- http://themes.eea.eu.int/IMS/CSI/
- http://www.euro.who.int/ehindicators/
- http://unece.org/env/europe/monitoring/IandR_en.html
- http://unece.org/env/europe/monitoring/EnvMonRep/index.html

WATER LOSSES

General description

26. **Brief definition:** The quantity of freshwater lost during transport (due to leakage), between a point of abstraction and a point of use, and between points of use and reuse.

27. **Unit of measurement:** Millions of cubic metres/ year.

Relevance for environmental policy

28. **Purpose:** The indicator provides a measure of response to the efficiency of the water management system in a country.

29. **Issue:** Sustainable management of water resources has become a major concern in many countries. The efficiency of water use is a key in matching supply with demand. Reducing losses, using more efficient technologies and keeping water transportation systems in good condition are part of the solution. The amount of water lost during transport to uses is an indicator of the efficiency of a water management system, including technical conditions affecting water supply pipelines, water pricing and public awareness in a country.

30. **International agreements and targets**: None.

Methodology and guidelines

31. **Data collection and calculations:** When working with this indicator the most important issue is to have data on the quantities of freshwater undersupplied to the users during transport by water supply industries (the companies collecting, purifying and distributing water through a permanent infrastructure). The indicator is estimated and defined as the difference between the amount of water abstracted by the water supply industry and the amount delivered to users (households; agriculture, forestry and fishing; manufacturing, the electricity industry and other

economic activities). Total losses can be broken down into losses by evaporation and losses by leakage. Losses due to illegal tapping or other illegal use of water are excluded. Reports submitted by enterprises are processed first at the regional and then at the country level. Information concerning this indicator or a set of indicators defining the structure or volume of water use is published in statistical yearbooks as well as in specialized collections dealing with environmental issues. Such information is presented in a more comprehensive format in water cadastre materials.

32. **Internationally agreed methodologies and standards**: None.

Data sources and reporting

33. Data are collected based on statistical reporting by countries. In many EECCA countries databases of fairly comprehensive time series exist. EECCA countries report data to UNSD in response to the UNSD/UNEP Questionnaire on Environmental Statistics.

References at the international level

- Convention on the Protection and Use of Transboundary Watercourses and International Lakes
- International Standard Industrial Classification of All Economic Activities. United Nations, Series M No.4, Rev.3.
- AQUASTAT – FAO's global information system on water and agriculture
- http://www.unece.org/env/water/links/link.htm
- http://www.unece.org/env/water/pdf/waterconr.pdf
- http:/europa.eu.int/comm/eurostat
- http://www.fao.org
- http://unstats.un.org/unsd/environment/questionnaire2004.htm/
- http://themes.eea.eu.int/IMS/CSI/
- http://www.euro.who.int/ehindicators/
- http://unece.org/env/europe/monitoring/IandR_en.html
- http://unece.org/env/europe/monitoring/EnvMonRep/index.html

REUSE OF FRESHWATER IN MANUFACTURING INDUSTRIES

General description

34. **Brief definition:** The share of reused or recycled water in the total volume of water used to cover manufacturing industry production needs. The indicator defines the percentage of water saved by applying recycling and reused water supply systems.

35. **Unit of measurement**: Percentage.

Relevance for environmental policy

36. **Purpose:** The indicator provides a measure of response to the efficiency of water management systems in manufacturing industries.

37. **Issue:** Sustainable management of water resources has become a major concern in many countries. Efficient water use is a key concern. Reducing losses, using more efficient technologies, recycling and reuse are all part of the solution in manufacturing industry. This indicator allows observation of tendencies in the technological development of production in industries and regions. The indicator is an important one for public authorities and for the management of industrial enterprises so as to develop production facilities in a targeted manner that ensures efficient water consumption.

38. **International agreements and targets**: None.

Methodology and guidelines

39. **Data collection and calculations:** The water use indicator is a ratio of the amount of recycled and reused water to the sum of the quantities of such water and water used to cover production needs. The indicator can be presented using the following formula:

$$\%_{\text{rec./reused}} = \frac{(Q_{\text{recycled}} + Q_{\text{reused}}) \times 100}{(Q_{\text{recycled.}} + Q_{\text{reused}}) + Q_{\text{produc}}}$$

where

% rec./reused is the share of recycled and reused water;

$Q_{recycled.}$ is the quantity of recycled water;

Q_{reused} is the quantity of reused water; and

$Q_{produc.}$ is the quantity of water used for production needs.

40. This indicator is a derivative of quantity ratios (quantity of water used for production needs, quantity of water used in recycled water supply systems, quantity of reused water) reflected in the special form of state statistical reporting. Data should cover production units defined as belonging to the manufacturing industry (ISIC 15-37) according to the International Standard Industrial Classification of All Economic Activities (ISIC Rev. 3.1). Data on this indicator are published in statistical yearbooks as well as in specialized collections dealing with environment issues. The information appears in a more comprehensive format in water cadastre materials.

41. **Internationally agreed methodologies and standards**: None.

Data sources and reporting

42. Data are collected according to state statistical reporting. Many EECCA countries have databases that provide fairly comprehensive time series. EECCA countries reported data to UNSD in response to the UNSD/UNEP Questionnaire on Environment Statistics.

References at the international level

- Convention on the Protection and Use of Transboundary Watercourses and International Lakes
- http://www.unece.org/env/water/links/link.htm
- http://www.unece.org/env/water/pdf/waterconr.pdf
- http://unstats.un.org/unsd/environment/questionnaire2004.htm/
- http://themes.eea.eu.int/IMS/CSI/
- http://www.euro.who.int/ehindicators/
- http://unece.org/env/europe/monitoring/IandR_en.html
- http://unece.org/env/europe/monitoring/EnvMonRep/index.html

DRINKING WATER QUALITY

General description

43. **Brief definition**: Share of samples failing drinking water quality standards in the total number of drinking water samples.

44. **Unit of measurement**: Percent.

Relevance for environmental policy

45. **Purpose:** The indicator provides a measure of the impact on drinking water quality and human health, and it shows the extent to which the drinking water supply conforms to sanitary requirements and standards.

46. **Issue**: Public health cannot advance without access to an adequate supply of clean drinking water. The quality of drinking water is still an area of concern throughout the EECCA countries, with significant microbiological contamination of supplies and the proportion of samples exceeding the fecal contamination standards ranging from 5 per cent to 30 per cent (WHO). The indicator is a measure of the extent to which drinking water is contaminated by chemical and microbiological contaminants, and thus it can serve as a mechanism for warning of situations that require further in-depth investigation and countermeasures.

47. **International agreements and targets:** The Protocol on Water and Health to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. The Signatories agreed to take all appropriate measures necessary to achieve:

- Adequate supplies of wholesome drinking water;
- Adequate sanitation of a standard that sufficiently protects human health and the environment;
- Effective protection of water resources used as sources of drinking water.

Methodology and guidelines

48. **Data collection and calculations:** The indicator is estimated from the available data on the compliance of drinking water with the parameters that are directly linked to human health. The microbiological quality of the drinking water should be expressed through *E. coli* and *Enterococci*. Countries may report other microbiological quality criteria, particularly *Pseudomonas aeruginosa.* A "core group" of 10 chemical quality parameters can be selected. The list of chemical parameters of the EU Drinking Water Directive Annex I Part B can serve as a reference. Turbidity could be included among the chemical parameters. For each parameter the mathematical expression would be the proportion of drinking water samples analyzed that fail to comply with the relevant standards. The data should be collected for a total number of regulatory analyses made by an official monitoring agency or undertaker within the defined spatial unit (a water supply zone or other regional entity defined for regulatory purposes in the country) over a given time period (e.g. one year) (T) and the number of non-compliant samples (E) found in the spatial unit. The "percentage compliance" indicator can be computed as: ((T - E)/T) x 100. The number of sampling points in the system of both centralized and decentralized drinking water supply as well as the frequency of sampling should provide statistical authenticity regarding the number of samples failing the standards. Some EECCA countries might not have the necessary calculation capacity to provide national weighted data. In that case the reporting could be started as a non-weighted system, listing the performance of individual suppliers.

49. **Internationally agreed methodologies and standards:** WHO *Guidelines for Drinking-water Quality* (3rd ed.). The EC Drinking Water Directive (98/83/EC) sets standards for the most common 48 parameters, based on WHO guidelines.

Data sources and reporting

50. Data at the international level are available from WHO and other organizations. EECCA countries have long-term departmental databases on the quality of drinking water.

References at the international level

- WHO Guidelines for Drinking-water Quality (3rd ed.), ol.1. (WHO, 2004)
- Recommendations. (WHO).
- Consultation on target setting and progress monitoring of water and wastewater services. Copenhagen, 9–10 May 2005. Report. (WHO/Europe)
- GEMS/WATER Operational Guide. 3rd ed. (WHO, 1992)

- EUROWATERNET. The Environment Agency's Monitoring and Information. Network for Inland Water Resources. Technical Guidelines for Implementation. Technical Report No. 7. (Copenhagen, 1998)
- Protocol on Water and Health to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes
- Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption
  http://www.who.int/water_sanitation_health/dwq/gdwq3/en/index.html
- http://www.euro.who.int/document/wsn/protMtgMay05.pdf
- http://www.euro.who.int/ehindicators/
- http://unece.org/env/europe/monitoring/IandR_en.html
- http://unece.org/env/europe/monitoring/EnvMonRep/index.html
- http://www.europa.en.int/comm/eurostat/
- http://unstats.un.org/unsd/environment/questionnaire2004.htm/
- http://themes.eea.eu.int/IMS/CSI/

OXYGEN-CONSUMING SUBSTANCES IN RIVERS

General description

51. **Brief definition:** Oxygenation status of water bodies expressed in BOD (biochemical oxygen demand) which is the demand for oxygen resulting from organisms that consume oxidizable organic matter and concentrations of ammonium (NH_4) in rivers.

52. **Unit of measurement:** The annual average BOD after five or seven days' incubation (BOD_5/BOD_7) is expressed in milligrams of O_2/litre; the ammonium concentration is expressed in micrograms of N/litre.

Relevance for environmental policy

53. **Purpose:** The indicator provides a measure of the state of rivers in terms of oxygenation status.

54. **Issue:** Large quantities of organic matter (microbes and decaying organic waste) can reduce the chemical and biological quality of river water and result in impaired biodiversity of aquatic communities and microbiological contamination that can affect the quality of drinking and bathing water. Sources of organic matter include discharges from wastewater treatment plants, industrial effluents and agricultural run-off. Organic pollution leads to higher rates of metabolic processes that demand oxygen. This could result in the development of water ions without oxygen (anaerobic conditions). The transformation of nitrogen into reduced forms under anaerobic conditions in turn leads to increased concentrations of ammonium, which is toxic to aquatic life above certain concentrations, depending on water temperature, salinity and pH.

55. **International agreements and targets:** The Convention on the Protection and Use of Transboundary Watercourses and International Lakes and its Protocol on Water and Health.

There is no international target for the oxygenation status of water bodies. In the European Union, the environmental quality of surface waters with respect to organic pollution and ammonium and the reduction of the loads and impacts of these pollutants are objectives of several directives, including the Surface Water for Drinking Directive (75/440/EEC), which sets standards for the BOD and ammonium content of drinking water, the Nitrates Directive (91/676/EEC), aimed at reducing nitrate and organic matter pollution from agricultural land; the Urban Waste Water Treatment Directive (91/271/EEC); aimed at reducing pollution from sewage treatment works and certain industries; the Integrated Pollution Prevention and Control Directive (96/61/EEC), aimed at controlling and preventing the pollution of water by industry; and the Water Framework Directive, which requires the achievement of "good ecological status" or "good ecological potential" for rivers throughout the European Union by 2015.

Methodology and guidelines

56. **Data collection and calculations:** The key indicator for the oxygenation status of water bodies is the biochemical oxygen demand (BOD) which is the demand for oxygen resulting from organisms in water that consume oxidisable organic matter. The indicator illustrates the current situation and trends regarding BOD and concentrations of ammonium (NH4) in rivers. The programme of monitoring biochemical demand for oxygen and ammonium should be structured taking into account the spatial and temporal dynamics of the indicator. The number of surveillance points and their location should enable collection of information on BOD background values for the main morphological types of watercourses and values of this indicator in the areas subject to anthropogenic (predominantly household) load. Time parameters should correspond to hydrological phases, while the frequency of sampling should reflect the need for statistically 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 measurement quality control systems.

57. Major difficulties in obtaining representative data on the value of BOD and ammonium in rivers are confined to low discretion of surveillance through monitoring networks in EECCA countries and to a lack of the financing required for optimization of the existing networks.

58. **Internationally agreed methodologies and standards:** The method of determining BOD in EECCA countries is in compliance with ISO 5815-1:2003 and ISO 5815-2:2003. The maximum permissible value of BOD_5 pursuant to EC Council Directive (78/659/EEC) on the quality of fresh waters needing protection or improvement in order to support fish life is 3mg/l of O_2 for salmonid waters and 6mg/l of O_2 for cyprinid waters.

Data sources and reporting

59. EECCA countries have departmental and in some cases national databases on the indicator. At the international level, such information on certain basins is stored in databases maintained by the International River Commissions. EECCA countries reported data to the European Environment Agency (EEA) for the *Kiev Assessment* and to UNSD in response to the UNSD/UNEP Questionnaire on Environment Statistics.

References at the international level

- ISO Water Quality – determination of BOD after five days. ISO 5815. 1989
- Fomin, G.S. *Water: Control of Chemical, Bacterial and Radiation Safety According to International Standards.* (Moscow: Protector, 1995)
- *Standard Methods for the Examination of Water and Wastewater*. 19th ed. (American Public Human Health Association, 1992)
- *GEMS/WATER Operational Guide*. 3rd ed. (WHO, 1992)
- Directive 2000/60/EC of the European Parliament and the Council
- Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control
- Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment
- Council Directive 75/440/EEC of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water in the Member States
- European Communities Directive 78/659/EEC on the quality of fresh waters needing protection or improvement in order to support fish life
- http://www.un.org/esa/sustdev/natlinfo/indicators/isd.htm
- http://www.iso.org
- http://europa.eu.int/comm/eurostat/
- http://www.unece.org/env/water/welcome.html
- http://www.unep.org
- http://www.icpdr.org/pls/danubis/DANUBIS.navigator
- http://www.iksr.org/
- http://www.greenfield.fortunecity.com/hunters/228/toppagel.htm
- http://www.cciw.ca/gems/intro.html
- http://unstats.un.org/unsd/environment/questionnaire2004.htm/
- http://themes.eea.eu.int/IMS/CSI/
- http://www.euro.who.int/ehindicators/
- http://unece.org/env/europe/monitoring/IandR_en.html
- http://unece.org/env/europe/monitoring/EnvMonRep/index.html

NUTRIENTS IN FRESHWATER

General description

60. **Brief definition:** Concentrations of orthophosphate and nitrate in rivers, total phosphorus and nitrate in lakes and nitrate in groundwater.

61. **Unit of measurement:** Concentrations of nitrate are expressed as milligrams of NO_3/litre, and concentrations of phosphorus and orthophosphate as micrograms of P/litre.

Relevance for environmental policy

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

63. **Issue:** Large inputs of nutrients to freshwater bodies from urban areas, industry and agricultural areas can lead to eutrophication. 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 for human consumption and other purposes. The indicator can be used to illustrate current geographical variations in nutrient concentrations and long-term trends.

64. **International agreements and targets:** The UNECE 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 sources. The indicator is not directly related to a specific policy target. The environmental quality of surface waters with respect to eutrophication and nutrient concentrations is an objective of several EU directives:

- The Drinking Water Directive (98/83/EC) establishes a maximum allowable concentration for nitrate of 50 mg/l;
- The Surface Water for Drinking Directive (75/440/EEC) sets a guideline concentration for nitrate of 25 mg/l;
- The Nitrates Directive (91/676/EEC) requires the identification of groundwater sites/bodies where the annual average nitrate concentration exceeds or could exceed 50 mg NO_3/l;
- The Urban Waste Water Treatment Directive (91/71/EEC) aims to decrease organic pollution.
- An OECD report of 1980 defines lakes as eutrophic when annual lake P exceeds 35 mg P/l.

Methodology and guidelines

65. **Data collection and calculations**: The nitrate separation method is based on the reduction of nitrates to nitrites by the use of metallic cadmium, with subsequent photometric measurement of nitrites. The method of defining phosphates is based on their reaction with ammonium molybdate in an acid solution in the presence of antimony ions and subsequent photometric measurement of the recovered complex. 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 and the values of this indicator in areas subject to anthropogenic load resulting from spot and diffuse sources. Time parameters should correspond to hydrological phases, while the frequency of sampling should reflect the need for statistically 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 measurement quality control systems. Major difficulties in obtaining representative data on the content of nutrients in rivers are confined to low discretion of surveillance through monitoring networks in EECCA countries and to a lack of the financing required for optimization of the existing networks.

66. **Internationally agreed methodologies and standards:** The concentration of nitrates 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. Phosphorus concentrations are determined by using the ISO 6878:2004 method, which is in compliance with the corresponding method used by EECCA countries.

Data sources and reporting

67. At the international level, information on certain basins is stored in databases maintained by the international river commissions or programmes. EECCA countries have departmental and in some cases national databases on nutrients contained in freshwaters. EECCA countries reported data to EEA for the *Kiev Assessment* and to UNSD in response to the UNSD/UNEP Questionnaire on Environmental Statistics.

References at the international level

- Fomin, G.S. Water: Control of Chemical, Bacterial and Radiation Safety According to International Standards. (Moscow: Protector, 1995)
- Standard Methods for the Examination of Water and Wastewater. 19th ed. (American Public Health Association, 1992
- GEMS/WATER Operational Guide. 3rd ed. (WHO, 1992)
- Directive 2000/60/EC of the European Parliament and the Council
- Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption
- Directive 75/440/EC of the European Parliament and the Council
- Council Directive 91/271/EEC of 21 May 1991 on 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
- http://europa.eu.int/comm/eurostat/
- http://www.unep.org
- http://www.icpdr.org/pls/danubis/DANUBIS.navigator
- http://www.iksr.org/
- http://unstats.un.org/unsd/environment/questionnaire2004.htm/
- http://themes.eea.eu.int/IMS/CSI/
- http://www.euro.who.int/ehindicators/
- http://unece.org/env/europe/monitoring/IandR_en.html
- http://unece.org/env/europe/monitoring/EnvMonRep/index.html

NUTRIENTS IN COASTAL WATERS

General description

68. **Brief definition:** The presence in the coastal waters of nutrients (biogenic substances) used by plants and autotrophic bacteria to maintain vital activity, and affecting the biological productivity and ecological condition of coastal waters.

69. **Unit of measurement:** Concentrations of major biogenic substances (nitrates and phosphates) are expressed in micrograms/litre.

Relevance for environmental policy

70. **Purpose:** The indicator provides a measure of the state of coastal waters in terms of nutrient concentrations.

71. **Issue:** Nitrogen and phosphorus enrichment can result in a chain of undesirable effects, starting with excessive growth of plankton algae, which increases the amount of organic matter settling to the bottom. This development may be enhanced by changes in the species composition and functioning of the pelagic food web (e.g. the growth of small flagellates rather than larger diatoms), which leads to lower grazing by copepods and increased sedimentation. The consequent increase in oxygen consumption can, in areas with stratified water masses, lead to oxygen depletion, changes in community structure and death of the benthic fauna. Eutrophication can also increase the risk of algal blooms, some of them consisting of harmful species that cause the death of benthic fauna and wild and caged fish or shellfish poisoning of humans. Increased growth and dominance of fast-growing filamentous macroalgae in shallow sheltered areas is another effect of nutrient overload which can change coastal ecosystems, increase the risk of local oxygen depletion and reduce biodiversity and the availability of nurseries for fish.

72. **International agreements and targets:** The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes; the UNEP Global Program of Action for the Protection of the Marine Environment from Land-Based Activities; the Convention on the Protection of the Mediterranean Sea against Pollution (Barcelona, 1976); Convention on the Protection of the Black Sea against Pollution (Bucharest, 1992); the Environmental Programme for the Caspian Sea.

73. International targets related to the EECCA countries for reducing the amount of nutrients in coastal and marine waters are:

- HELCOM/Baltic Sea: 50 per cent reduction in nutrient discharges from the mid-1980s level;
- Black Sea Commission/Black Sea: Return to the pollution status of 1960.
- Targets have also been set for the North Sea, the Mediterranean Sea and the North-East Atlantic Ocean.

74. In the European Union, the Water Framework Directive gives a target of achieving “good ecological status” with regard to nutrient concentrations.

Methodology and guidelines

75. **Data collection and calculations:** The nitrate separation method is based on the breakdown of nitrates into nitrites by using metallic cadmium, with subsequent photometric measurement of nitrites. The method of defining phosphates is based on their reaction with ammonium molybdate in an acid solution in the presence of antimony ions and subsequent photometric measurement of the recovered complex. Major difficulties in obtaining representative data on the biogenic substances content of coastal waters are confined to low discretion of surveillance through monitoring networks in EECCA countries as well as to the lack of financing for optimization of the existing networks. A basic monitoring programme should specify biogenic

substances and a core list of measured indicators. The number of sampling points and their spatial location should enable the collection of information on the content of biogenic substances throughout the gradient of loads – from background water landing areas to coastal water areas exposed to substantive anthropogenic (predominantly agricultural and household) load. Time parameters should take into account the time mutability of the content of biogenic substances. Methodological and metrological uniformity of surveillance and data processing should be a goal; microbiological, and chemical-analytical activities should be conducted by accredited laboratories with measurement quality control systems.

76. **Internationally agreed methodologies and standards:** The concentration of nitrates is determined by using the ISO 7890-3:1988 method, based on spectrometric measurement of levels of the compound resulting from the reaction of nitrate with sulfosalicylic acid and its subsequent treatment with alkali. Phosphorus concentrations are determined by using the ISO 6878:2004 method, which is in compliance with the corresponding method used by EECCA countries.

Data sources and reporting

77. EECCA countries have departmental and in some cases national databases on biogenic substances contained in coastal waters. At the international level, information on certain basins is stored in databases maintained by the Regional Seas international commissions. EECCA countries reported emission data to UNSD in response to the UNSD/UNEP Questionnaire on Environmental Statistics.

References at the international level

- Fomin, G.S. Water: Control of Chemical, Bacterial and Radiation Safety According to International Standards. (Moscow: Protector, 1995)
- Guidance for monitoring water quality in transboundary rivers. In Protection of Transboundary Waters: Guidance for Policy- and Decision-Making. Water Series No. 3. ECE/CEP/11. United Nations Economic Commission for Europe. (United Nations, 1996)
- Standard Methods for the Examination of Water and Wastewater. 19th ed. (American Public Human Health Association, 1992)
- GEMS/WATER Operational Guide. 3rd ed. (WHO, 1992)
- Directive 2000/60/EC of the European Parliament and the Council establishing a framework for Community action in the field of water policy (OJ L 327/1 of 22.12.2000), as amended by Decision 2455/2001/EC of the European Parliament and the Council establishing the list of priority substances in the field of water policy (OJ L 331/1 of 12.12.2001)
- Convention on the Protection and Use of Transboundary Watercourses and International Lakes
- http://www.unece.org/env/water/welcome.html
- http://www.unep.org
- http://www.raceagainstwaste.com/prod.htm
- http://www.unhabitat.org
- http://www.iso.org
- http://www.fao.org.

- http://www.helcom.fi/
- http://www.blacksea-commission.net/
- http://www.grida.no/caspian/
- http://www.vyh.fi/eng/orginfo/publica/electro/fe524/fe524.htm
- http://unstats.un.org/unsd/environment/questionnaire2004.htm/
- http://themes.eea.eu.int/IMS/CSI/
- http://www.euro.who.int/ehindicators/
- http://unece.org/env/europe/monitoring/IandR_en.html
- http://unece.org/env/europe/monitoring/EnvMonRep/index.html