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INDICATORS FOR ASSESSING PROGRESS TOWARDS THE 2010 TARGET: WATER QUALITY IN AQUATIC ECOSYSTEMS

Note by the Executive Secretary

I. SUMMARY

1. Water quality data represent one of the most comprehensive sources of indicator data for measuring the health and sustainability of aquatic systems. They are multi-functional and indicate both major threats to the sustainability of freshwaters and unsustainable activities outside that ecosystem. The health of freshwaters is an excellent indicator of the health of terrestrial ecosystems. The indicator is also very useful in that it can, and in some cases already does, indicate the impact of responses to environmental problems (e.g., successful policy interventions leading to improved water quality). Limitations include the indicator being composed of a multitude of potential sub-indicators, data for which vary widely regionally, in quality and availability. It is difficult to compile a suite of sub-indicators into a valid quantified single global index. Some solutions to this problem exist.

2. Certainly, water quality as an indicator for the present purposes deserves serious further consideration. A task force should be established to develop the indicator further which should also be charged with assessing the potential of a second related indicator – that for water use (water quantity in aquatic systems).

II. RELATION OF INDICATOR TO FOCAL AREA

3. Water quality is a direct indicator of stresses to biodiversity in inland waters. It also indicates unsustainable practices occurring outside of the aquatic system since most drivers of water quality change arise from land-based activities. Water quality is also an issue in coastal and marine areas. However, most of the pollutants (etc.) entering these environments originate from inland waters (from river run-off). Therefore, efforts designed to improve water quality in coastal areas must focus on improving or sustaining water quality in inland waters. However, water quality data for coastal and marine regions can be used as indicators of water quality in relevant inland areas.

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III. GENERAL DESCRIPTION

4. Trends in water quality often represent trends in human impacts on freshwaters. Water quality can deteriorate indicating unsustainable water use, or improve, indicating progress towards environmental sustainability due to improved management efforts. Both trends can be expected depending upon the region and parameters selected.

5. "Water quality" is a composite indicator made up of several parameters each describing the chemical composition of water, and other characteristics, as referred to a desired natural state. A list of some of the parameters used to describe "water quality" is provided in the annex. Trends in different aspects of water quality are driven by different human activities.

6. Specific indicators are trends in selected water quality parameters.

IV. POLICY RELEVANCE

7. Inland water ecosystems are amongst the most threatened on earth and subject to the most pressing requirements for improved attention to sustainable use (due to the rapidly increasing demand for water).

8. Water quality indicates the impacts of activities in other sectors.

9. Most other work programmes of the Convention on Biological Diversity have direct and intimate linkages to inland waters.

10. Water quality has direct relevance to the following targets of the Convention on Biological Diversity:

(a) Goal 5: Pressures from habitat loss, land use change and degradation, and unsustainable water use, reduced.

Target 5.1: Rate of loss and degradation of natural habitats decreased

(b) Goal 7: Address challenges to biodiversity from climate change, and pollution

Target 7.2: Reduce pollution and its impacts upon biodiversity

(c) Goal 8: Maintain capacity of ecosystems to deliver goods and services and support livelihoods

Target 8.1: Capacity of ecosystems to deliver goods and services maintained
Target 8.2: biological resources that support sustainable livelihoods, local food security and health care, especially of poor people maintained.

11. Water quality is also relevant to other global development targets including MDG goal 7: Ensure environmental sustainability:

In particular targets:

(a) Halve by 2015 the proportion of people without sustainable access to safe drinking water;
(b) Reverse the loss of environmental resource.s

Plan of Implementation of the World Summit on Sustainable Development:

12. *Halve, by the year 2015, the proportion of people who are unable to reach or to afford safe drinking water (as outlined in the Millennium Declaration) and the proportion of people who do not have access to basic sanitation;*

13. *Develop integrated water resources management and water efficiency plans by 2005.*

14. Water issues have remained high on the international environment agenda since the Millennium Summit. At the 2002 World Summit on Sustainable Development (WSSD), protection and management of water resources was recognized by world leaders as fundamental for all three pillars of sustainable development. The Water, Energy, Health, Agriculture and Biodiversity (WEHAB) Initiative targets actions to facilitate sustainable development in five key areas, water and sanitation – and energy, health,

agriculture and biodiversity – in which water resources also play a significant part. The WSSD reaffirmed the MDG target on water and added two more development targets related to water: a target for integrated water resources management and a target for improved sanitation. This reflects the growing severity of water problems and the urgent need for solutions. International attention on water will continue, particularly with the water and sanitation theme of CSD12 and the recently-declared United Nations International Decade of Action on Water between 2005–2015. This will build on the efforts made in 2003: the International Year of Freshwater.

V. TECHNICAL INFORMATION

A. Brief definition

15. Water quality is the extent to which the chemical, and other, characteristics of water approach a pre-defined desired state. The technical aspects of that state vary according to the parameter in question (annex).

16. However, common use of the term the "desired state" is not necessarily a natural one. For example, water quality standards for drinking water can require the water to have levels of certain chemicals below that which naturally occur in the source water in question. However, this is a matter of interpretation of the data, not for data collection. For the present purposes standards for water quality can be determined as those which sustain as near natural levels as possible of biodiversity.

17. The natural chemical characteristics of water vary widely within and between aquatic systems and temporally (e.g., seasonally, or after flash flooding events). The desired state of water quality for some parameters will therefore be range of values with both spatial and temporal dimensions.

B. Data availability

18. Water quality data are routinely available for major waterways in a large number of countries. Water quality data are one of the most comprehensive data sources for inland waters. The Global Environment Monitoring System (GEMS) Water Programme (www.gemswater.org) maintains a database for water quality, which compliments a second database for hydrological data (under the Global Runoff Data Centre of WMO). It currently collects data from 902 stations worldwide. Over 100 water quality parameters are included with over 2 million data points with a good time series (table 1). Regional coverage is good (figure 1).

Fig. 1: Distribution of over 900 water monitoring stations reporting water quality data to the GEMS-Water Programme.

Table 1: Global data coverage for the GEMS-Water database for water quality (January 2004).

Region	Number of Stations	Number of data points	Physical/ chemical	Major ions	Metals	Nutrients	Organic contaminants	Micro-biology	Date range
Africa	74	12,287	2,024	3,921	970	1,914	4	339	1978-2000
Americas	114	182,852	33,269	35,320	31,316	27,224	3593	9389	1976-1999
W. Asia	189	62,094	13,181	16,798	10,691	10,333	366	3150	1979-2003
Europe	296	815,759	140,836	132,720	145,457	107,930	13,036	24,401	1971-2002
S.E. Asia	189	362,937	84,619	109,300	20,148	58,681	267	18,337	1978-2002
E.Asia/ Pacific	148	408,807	63,206	45,587	55,229	73,692	6,649	10,624	1979-2003
Total	902	1,844,736	337,135	343,646	263,811	279,774	23,915	66,240	1971-2003

19. Different health requirements and water uses need different degrees of water quality. The needs of an aquatic ecosystem are the most important. If the ecosystem is healthy, then the others fall into place. The suite of substances that can be monitored are:

Table 2: Water Quality measures vary depending on water use

Service and Use	**Human Health Drinking Water**	**Agriculture**	**Municipal/ Industrial, Energy**	**Ecosystem Stability, Structure & Health**	**Tourism & Recreation**
Parameter	Total Coliform Faecal Coliform Pathogens POPs Turbidity	Nutrients Nitrogen Phosphorus Salinity Chlorophyll A	BOD COD Heavy Metals (particularly in Sediment)	Temperature pH - acidity Conductivity Major ions Oxygen Suspended Solids Biodiversity	Parasites Pathogens

20. The main issue for the water quality and biodiversity issue is to establish which substances and parameters yield the most information about biodiversity health and ecosystems, and trends.

21. The GEMS-Water Programme has recently initiated a major effort to improve data availability through the "Great Water Quality Data Drive" which is a global call to action for water quality monitoring and data from all types of water resources". Given sufficient support, the prospects of improved data availability are good. Much data are already available but not reported.

C. Data quality

22. By comparison to some indicators, data are of generally high quality. For most parameters well established and accurate methods of analysis are available. The accuracy and extent of coverage, however, vary considerably between different water quality parameters.

23. A brief overview of needs for improvement is provided in box1.

Box 1: Water quality data

Existing water quality data collection and monitoring systems are inadequate because of:

- incomplete data coverage (spatial and temporal);
- slow reporting and sharing of data; and
- insufficient training and capacity of local water authorities to collect data. The main steps to invest in monitoring, assessment, and information systems are to:
- include monitoring programmes in water management plans, and invest in data collection and analysis capacity in countries, particularly in Africa, SIDS and Central Asia;
- encourage country participation in regional and global water quality monitoring and assessment programmes, such as GEMS/Water; and
- ensure that data and information about water quality are collected frequently and regularly using comparable methods.
- Over 800 stations for freshwater monitoring worldwide have contributed data to the UNEP GEMS/Water Programme (see map below). Of these, 98 are measuring water quality in lakes and reservoirs. There are four types of stations:

Baseline stations are located in areas where there is little or no effect from point sources of pollutants and removed from obvious anthropogenic influences;

Impact stations are located at sites with at least one major use of the water such as drinking water supply, irrigation, or conservation of aquatic life; **Trend stations** are primarily located on large rivers that are representative of large basins in which human activity is high; and **Flux stations** are monitoring at the mouths of major rivers upstream from estuarine effects.

By the end of 2003, the GEMS/Water database contained more than two million data points covering over 100 water quality parameters, including physical/chemical parameters, such as temperature, pH, major ions, nutrients, metals, microbiological parameters, and organics. As the requirements for assessment and identification of national, regional and global water quality issues of concern increase, the need for data that accurately reflect environmental conditions becomes greater.

The geographic distribution of the data contained in the GEMS/Water database is widespread with a higher concentration of stations in European countries, India and Japan.

Source: UNEP GEO Yearbook 2003, p 43.

D. Data sustainability

24. Prospects for data sustainability are excellent. Water quality monitoring and assessment are a high priority for most countries. The availability and quality of data are in fact likely to significantly increase. Indicator development creates a demand for these data.

25. There are a number of international and regional organizations dealing with water quality data. The GEMS-Water Programme might be the lead agency in the United Nations system, although a

number of other agencies can be involved including the UNESCO-IOC Global Nutrient Export from Watersheds Project, Word Resources Institute, United States Geological Survey, European Environment Agency and other national and regional institutes.

Limitations

26. Limitations include that the impacts of water quality on biodiversity are not particularly well understood except for the most severe cases of poor water quality (e.g., deoxygenation of rivers or lakes, localized pollution spills etc.). It is however known that a reasonable level of water quality is required in order to sustain the biodiversity of inland waters although this is rarely quantified. In general, improving or sustaining water quality remains high on the agenda of most policies and management agencies.

27. The indicator is complicated by the fact that water quality depends on a number of associated, and important, variables. In particular, water extraction from rivers reduces flow rates, which in turn concentrates chemicals in the remaining water.

28. Although water quality is an important indicator of the condition of inland waters it is probably not the most important. Unfortunately, the indicator on water quality provides limited information on the quality of habitat for biodiversity and no indication of habitat extent. It is, for example, quite feasible to have inland waters with high water quality but low biodiversity values. Other parameters of importance are, particularly in rivers, hydrological conditions (especially ecological flows), fragmentation and loss of habitat (wetlands). For these reasons water quality data must be complimented by data that reflect the biodiversity values of inland water habitat – without that there is a danger that positive trends in water quality will mask negative trends in biodiversity.

29. One problem is amalgamating different sub-indicators (e.g., annex) into a global indicator or index of water quality. Trends in different parameters have different implications for biodiversity.

30. The main problem with definitions is determining the desired state of water. This differs between various objectives for water management and differs considerably from location to location (habitat type) within ecosystems. Whilst this is less of a problem with the presence of un-natural chemicals in water (e.g., agricultural chemicals) it is problematic for naturally occurring chemicals or substances (e.g., sediment loads).

VI. APPLICATION OF THE INDICATOR AT NATIONAL/REGIONAL LEVEL

31. The indicator on water quality or specific parameters such as biological oxygen demand (BOD) is in widespread, and long established, use at national level.

VII. SUGGESTIONS FOR THE IMPROVEMENT OF THE INDICATOR

32. Water is often key in terms of poverty alleviation, consumption, production, sanitation, human settlements and biodiversity. Transboundary water resource issues are important in terms of governance and sustainability. Water sustains all life and links environmental issues on land to marine areas. It is therefore, essential that freshwater, including groundwater, and marine issues are considered as part of an integrated system. Sound water management is important for the environment, for reducing human vulnerability resulting from degradation of water quality and water scarcity, and for enhancing human security and well-being through strategic and effective management responses. Water is a key component of all ecosystems. These provide critical goods and services to people, including materials, food and other organic products, water storage and purification, biogeochemical cycling and waste removal.

33. There is considerable worldwide interest in water and its availability (quantity) and quality. Hence, large databases occur – with good time series of data. Whilst there is significant scope for improving the quality and coverage of the data an adequate set already exists together with systems for monitoring and reporting regionally and globally. Certainly, for inland waters, water quality data, if not perfect, are by far the best currently available.

34. Advantages of these data, in addition to coverage and availability, is that they indicate a number of things simultaneously. Whilst most signal the health of aquatic systems, they also indicate unsustainable practices in various sectors. For example, increasing sediment loads are a threat to freshwaters – but also indicate unsustainable land use. Water quality, therefore, is a very good indicator of broader ecosystem health.

35. A major problem with "water quality" as an indicator is that it is composed of a large number of potential and optional sub-indicators. Any effective "water quality indicator" must, therefore, use a suite of sub-indicators. Choosing those indicators will be problematic because their importance, and data availability, differ considerably between regions. Equally problematic is that it is difficult, if not impossible, to amalgamate several sub-indicators into one global indicator (e.g., how to add together sediment load data with those for levels of POPs?) However, an agency could be responsible for compiling a suite of indicators into a global overview. The results may not be quantifiable (as a single numeric indicator) but it is more important to identify trends rather than absolute values.

36. Current assessments indicate that water quality is potentially a very good indicator for the present purposes and certainly justifies a task force looking into the issues in more detail. That task force should also be charged with looking into complimentary data (indicators). A "water use" indicator would be a useful enhancement to any adopted water quality indicator(s) (see annex).

VIII. SUMMARY OF COMMENTS RECEIVED ON THIS DOCUMENT

37. This document was available for review and comments in a discussion forum established on indicators for assessing progress towards the 2010 biodiversity target. Key comments received can be summarized as follows:

(a) This indicator or index should be developed to meet the needs of Ramsar, the World Water Development Report assessment process, the Convention on Biological Diversity and others. The goal should be one water quality index which combines information on organic and inorganic pollutants, sediments, watershed protection, alien and invasive species, water use, and man made obstacles;

(b) Freshwater invertebrates are excellent indicators of water quality. An indicator could be developed based on the abundance of certain taxa;

(c) While the link between water quality and biodiversity is complex we do have information on the consequences of most pollutants on major taxonomic groups;

(d) The document should strictly distinguish between targets and other reference values (e.g. natural background values, no observed effect concentration (NOEC));

(e) Water quantity and flow rates in rivers are excellent predictors of biodiversity. Water quality may not be the best indicators for the biodiversity of inland water ecosystems;

(f) In this document information on freshwater lakes is limited: the new Global Lakes and Wetlands Database (GLWD) may help to address this gap;

38. These comments are not reflected in this document. Registered participants in the discussion forum can access the https://www.biodiv.org/2010-target/forums/indicators-thread.shtml?postid=527. 1/

1/ To register and use the discussion boards for the first time: please go to <https://www.biodiv.org/2010-target/indicatorstf.shtml>

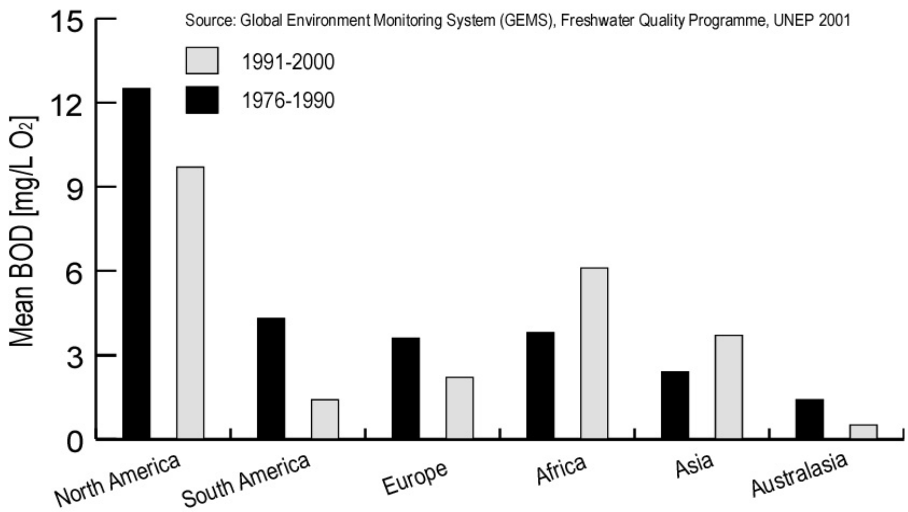
Annex

EXAMPLES OF SPECIFIC INDICATORS AND TRENDS

1. Biological oxygen diversity (BOD)

1. Biological oxygen demand is an indicator of the organic pollution of freshwater. In comparing the past two decades, rivers in Europe and Australasia show a statistically significant reduction in BOD concentrations. Although the reduction is not particularly large, it is indicative of positive trends (figure 1).

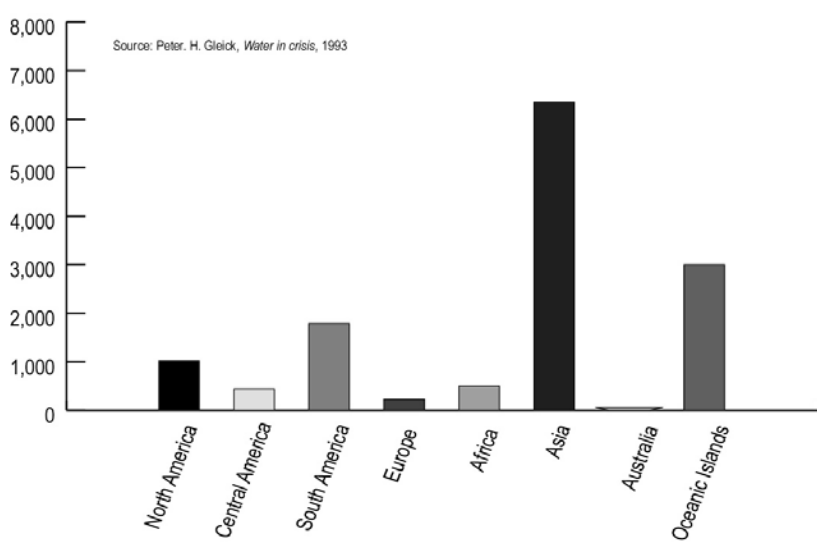
Figure 1. Changes in biological oxygen demand (BOD) of major water bodies on a regional basis



2. Sediment loads in rivers

2. The natural sediment load discharged through river systems is correlated with runoff volumes. Data for the early 1990s are available on a region-by-region basis (figure 2). 2/ Significant increases in sediment load are indicative of soil loss, mostly from unsustainable land use practices. Additional data are available from UNESCO-IOC Global Nutrient Export from Watersheds project, UNEP Global Environment Monitoring System (GEMS), WRI, USGS; EEA; as well as national and regional institutes.

Figure 2. Suspended sediment discharge per region (in million tonnes per year)



3. However, dams

2/ P.H. Gleick. 1993. Water in crisis. Oxford University Press, New York.

can reduce the amount of sediments carried by rivers (because sediments settle-out in the still waters behind dam walls). Since natural levels of sediments are required for proper ecosystem functioning (sediments provide nutrients to lowland waters – particularly floodplains and estuaries) – reduced sediment levels can also indicate environmental problems. Hence, there is a need to set desired targets for sediments which resemble those in natural systems, and which are not too low.

3. Pollutants etc.

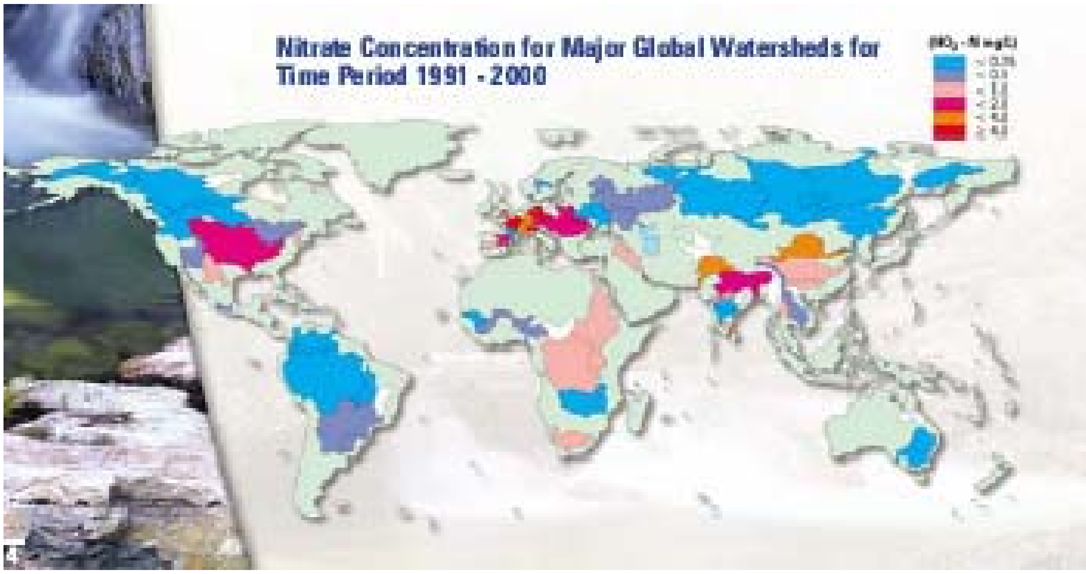
4. There are a large number of substances which enter and pollute freshwaters and these indicate unsustainable activities in various areas, according to the substance selected. Some examples are shown in table 2.

Table 2: Some examples of substances which are regularly monitored in freshwaters.

Substance	Main source of substance	Driver	Parameter of interest mainly to:
Bacteria: - total coliform - feacal coliform Pathogens Parasites	Human waste (mainly) Animal wastes	Poor sanitation	Public health authorities
Nutrients: - nitrogen - phosphorus	Agriculture	Unsustainable agriculture	Agriculture Natural Environment
Salinity (increased salts)	Naturally occurring	Unsustainable water use (salinity intrusion in estuaries, salination of floodplains/wetlands). Unsustainable land use	Water resources management. Natural Environment
Chlorophyl-a	Naturally occurring	Increases indicate eutrophication – caused by excessive nutrients and decreased water discharges.	Water resources management. Natural Environment
Heavy metals (numerous ctypes)	Naturally occurring at low levels.	Industry Mining.	Mining/Industry. Natural Environment Human health
Persistent Organic Pollutants (POPs)	Agricultural chemicals.	Unsustainable agriculture.	Agriculture. Natural Environment Human health

5. As an example, data for nitrate concentrations in freshwaters globally are illustrated in figure 3. This particular indicator is the aquatic ecosystem equivalent of global indicator number 10 (nitrogen deposition) in document UNEP/CBD/COP/7/INF/33 (and as described further in the note on nitrogen deposition (UNEP/CBD/AHTEG-2010-Ind/1/INF/4))

Figure 3: Nitrate concentrations for major global watersheds for the time period 1991-2000 (from GEMS-Water).

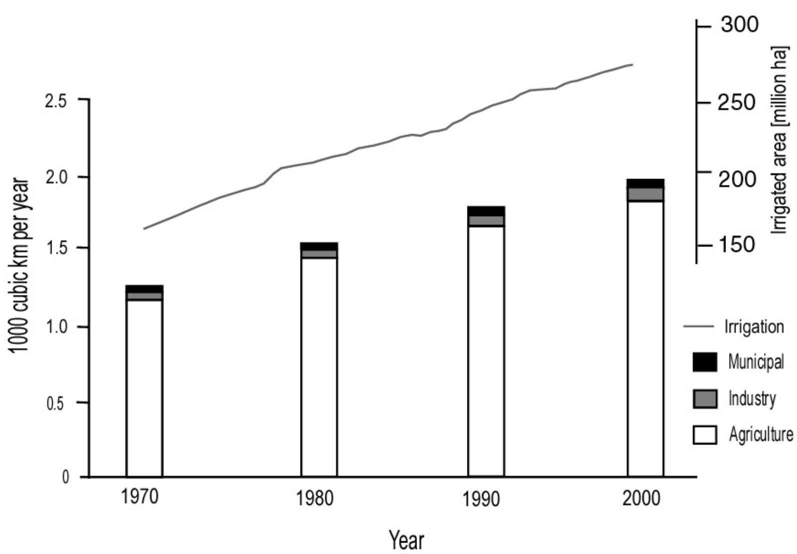


4. Water use monitoring

6. Because of the extreme importance of freshwater to most countries, both for its in-situ uses and extractive uses for such things as agriculture, industry and urban supply, there is a significant amount of data available globally on water resources, supply and use. Strictly speaking this is not a "water quality" issue but deals with the quantity, location and timing of availability of freshwater. However, water "quantity" (use) and "quality are closely related since disturbances in hydrological conditions, e.g., the amount of water available in systems influences the concentration of pollutants present.

7. For example, the uses of water globally by sector can be illustrated using widely available existing data (figure. 4). Increasing use (extraction) of water takes water away from other users – in particular the natural environment.

Figure 4: Water use by various sectors 1970-2000.



8. A number of global, regional and national initiatives have set targets for water use. For example, the Challenge Programme on Water and Food under the CGIAR has the target of maintaining extractions

for agriculture at year 2000 levels (www.cgiar.org). A number of agencies have or are developing databases on global water use including the International Water Management Institute (www.iwmi.org).
