European Environment Agency

Indicator Fact Sheet

(WQ1) Water exploitation index

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Indicator code / ID	WQ1
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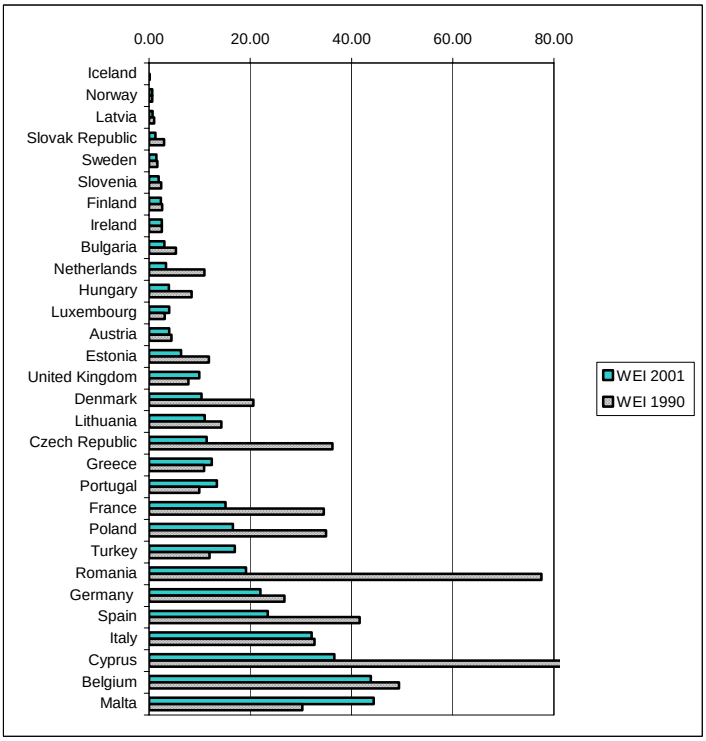
Key Message

O Six countries in the EEA area, in which 35 % of the population live, can be considered as moderately to highly water stressed.

☺ The Water Exploitation Index (WEI) has decreased in 22 countries of the EEA during the period 1990 to 2001.

Figure 1: Water exploitation index (%) across Europe



Data source: New Cronos (Eurostat JQ2002)

Results and assessment

Policy relevance:

This indicator can identify whether the rates of abstractions in countries are sustainable over the long term. It relates the use of water to the freshwater resources in a country, including surface and groundwater. The changes in WEI help to analyse how the changes in abstractions impact on the freshwater resources by adding pressure to them or by making them more sustainable.

Policy context:

The objective of the existing policy is to encourage resource efficiency through more sustainable consumption patterns. Hence one of the objectives of the Sixth Environment Action Programme for the EU (2001-2010) is "to ensure the rates of abstraction from our water resources are sustainable over the long term". In addition, the Water Framework Directive (2000/60/EC) aims at promoting sustainable water use based on a long-term protection of available water resources. Abstraction rates must be sustainable in order to ensure the protection and management of water resources and related ecosystems. The water exploitation index highlights those countries where freshwater resources are strained by water abstractions and are thus at a higher risk of suffering the consequences of water stress.

Environmental context:

The water exploitation index (WEI), or withdrawal ratio, in a country is defined as the mean annual total abstractions of freshwater divided by the mean annual freshwater resources. It describes how the total water abstractions put pressure on water resources. Thus it identifies those countries having high abstractions in relation to their resources and therefore are prone to suffer problems of water stress. The freshwater resources are derived from the mean annual precipitation minus the mean annual evapotranspiration plus the mean annual inflows in each country.

According to the literature, the warning threshold can be 20 %, which distinguishes a non-stressed region from a stressed region (Raskin et al., 1997, Lane et al., 2000). Severe water stress can occur where the WEI exceeds 40 %, indicating strong competition for water but which does not necessarily trigger frequent water crises. Some experts argue that 40 % is too low a threshold, and that water resources can be used much more intensely, up to a 60 % threshold. Others argue that freshwater ecosystems cannot remain healthy if the waters in a river basin are abstracted as intensely as indicated by a WEI in excess of 40 % (Alcamo et al., 2000).

Water stress in the long term can cause the deterioration of water ecosystems due to poor water availability in terms of quality and quantity. In addition, water stressed countries can face a problem of groundwater over-abstraction and the consequent water table depletion and salt-water intrusion in coastal aquifers.

Assessment:

There are six countries that can be considered water stressed (Germany, Spain, Italy, Cyprus, Belgium, and Malta), representing 35 % of Europe's population. The four former countries have a WEI between 20 and 40 %, and the two latter have a WEI around 45 %. However, it is necessary to take into account the high water abstractions for non-consumptive uses (energy production) in Germany and Belgium, while in the other four countries, most of the water abstracted is for consumptive uses (especially irrigation) and as a consequence there is a higher pressure on water resources. In Southern European countries, the pressure on water resources increases during summer when water abstractions are higher due to agricultural uses and increased demand from the tourist sector.

The water exploitation index decreased in 22 countries during the period 1990 to 2001, representing a considerable decrease in total water abstractions. Most of the decrease occurred in the Accession Countries, due to the decline of abstractions in most economic sectors. Institutional and economic changes have led to this trend. However, there are six countries (Luxembourg, United Kingdom, Greece, Portugal, Turkey and Malta) that have increased their WEI in the same period because of the increase in the total water abstraction, with the exception of Malta. In this last country, there has been a decrease in total water abstractions, but the data submitted for the last years on freshwater resources show large differences, which can explain this apparent inconsistency. In the case of UK, the higher WEI is a combination of

the increase in total water abstractions and a decrease in the reported freshwater resources.

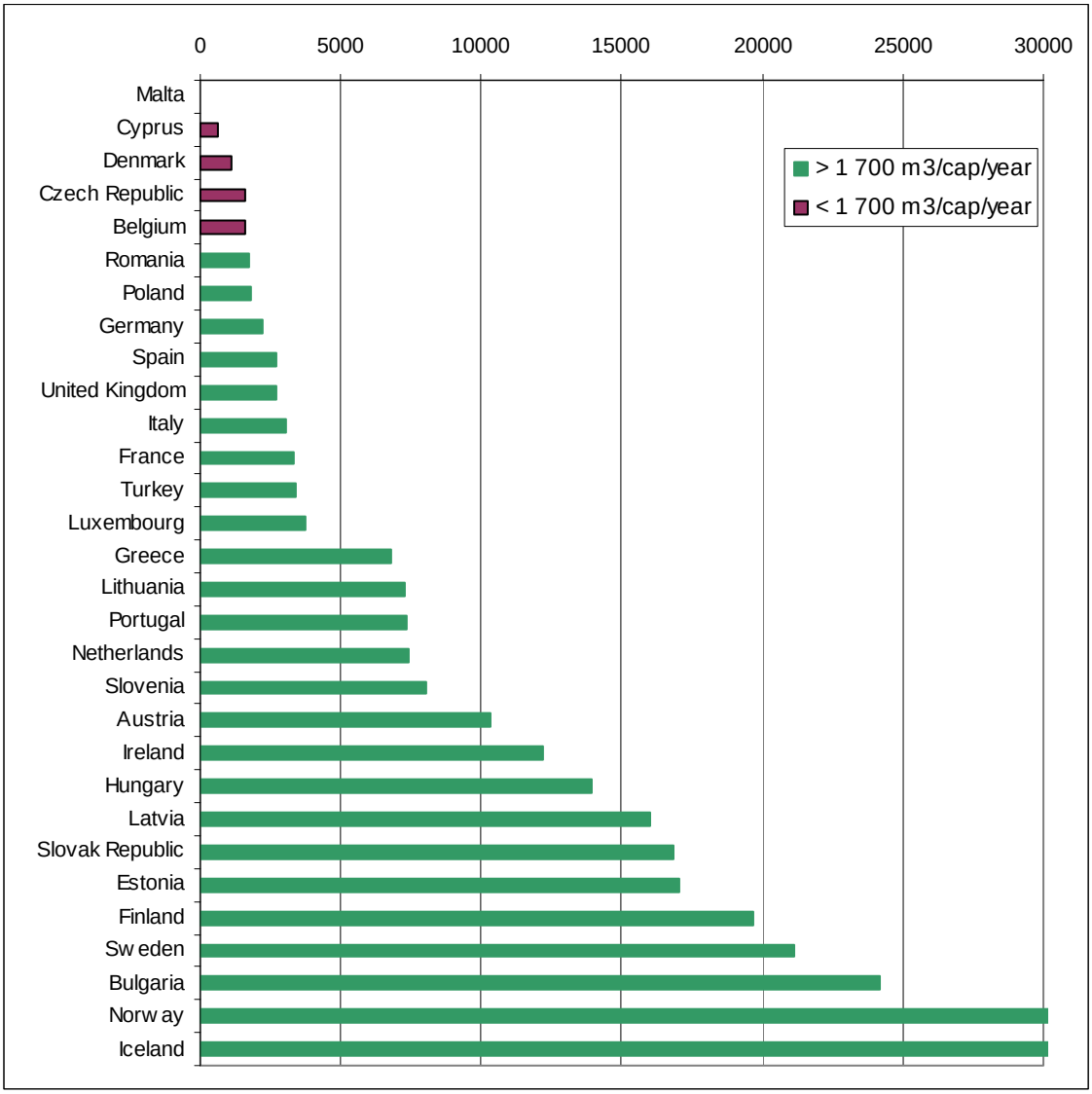
Sub-indicator

(WQ1a) Freshwater resources

Key Message

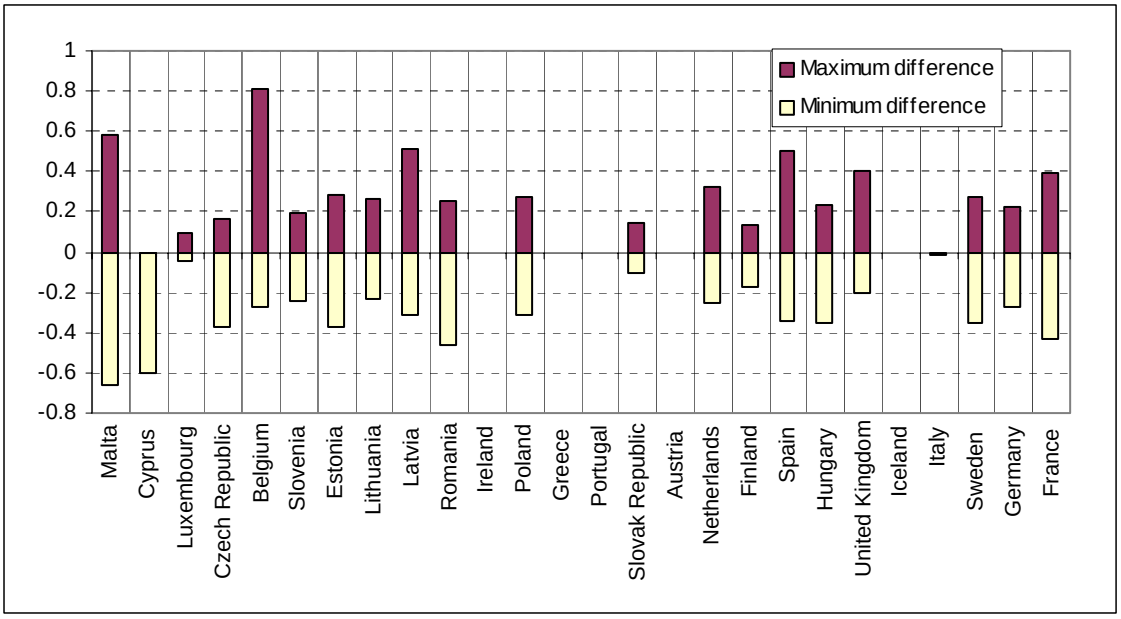
- Five countries have less than 1 700 m^3/cap/year, while the Northern and Central European countries have the highest water resources per capita.

Figure 2: Annual Water availability per capita and country (year 2001)



Data source: New Cronos (Eurostat, JQ2002) and World Bank

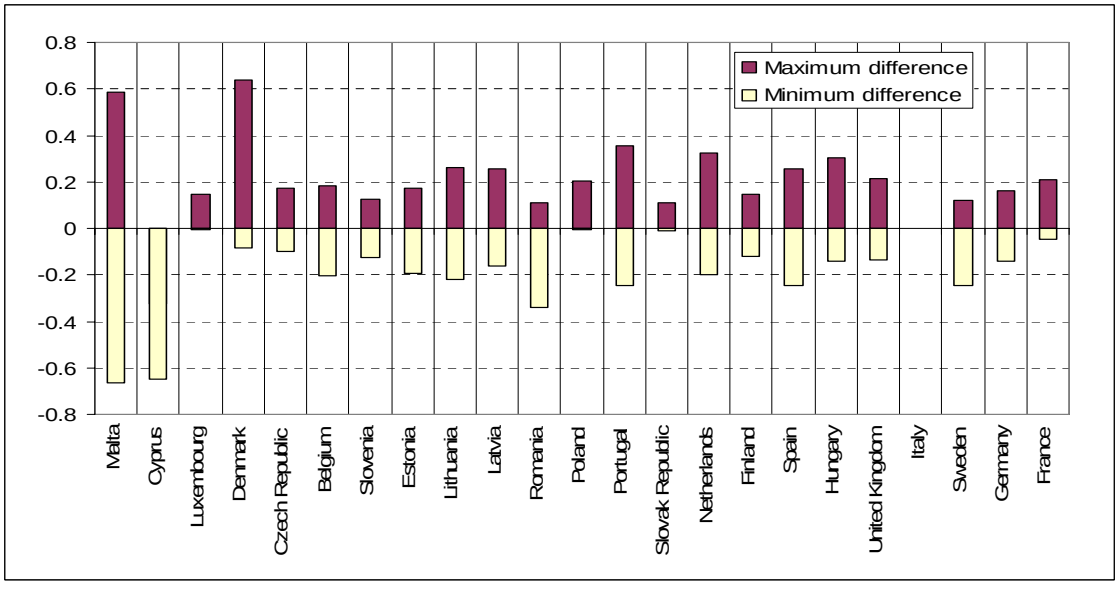
Figure 3: Differences in total freshwater resources with respect to the long term average



Data source: New Cronos (Eurostat)

Note: Long term average (normally 20 consecutive years, Eurostat)

Figure 4: Differences in precipitation with respect to the long term average



Data source: New Cronos (Eurostat)

Note: Long term average (normally 20 consecutive years, Eurostat)

Assessment:

The Falkenmark indicator is one of the most widespread used indicators for assessing the stress on water. It relates the total freshwater resources with the total population in a country and indicates the pressure that population puts on water resources, including the needs for natural ecosystems. Falkenmark developed this indicator on the grounds of a minimum need of 100 l/day/cap for household use and from 5 to 20 times as much as for agricultural and

industrial uses (Hinrichsen et al., 1998). The threshold for this indicator is that water stress begins at less than 1 700 m^3/cap/year (Cosgrove et al., 2000). When the indicator drops below 1 000 m^3/cap/yr, the country can face water scarcity (Hinrichsen et al., 1998). Shiklomanov made a classification of what he called "the specific water availability" (in m^3/cap/year) of countries, based on this indicator: < 1 000 is catastrophically low, between 1 000 and 2 000 is very low, between 2 000 and 5 000 is low, between 5 000 and 10 000 is average, between 10 000 and 20 000 is high and above 20 000 is very high.

Five countries (Denmark, Czech Rep, Belgium, Malta and Cyprus) have less than 1 700 m^3/cap/year according to the 2001 data. The two latter can be considered as facing water scarcity (< 1 000 m^3/cap/year). According to Shiklomanov´s classification, nine additional countries have very low or low water availability (up to less than 5 000 m^3/cap/year), see Figure 2 above, whilst the Nordic countries plus Bulgaria have very high water availability. There is a clear difference between the Southern countries, which have 3 400 m^3/cap/year on average and Central and Nordic countries, for which the Falkenmark indicator is almost twice as high (i.e. 6 600 m^3/cap/year on average).

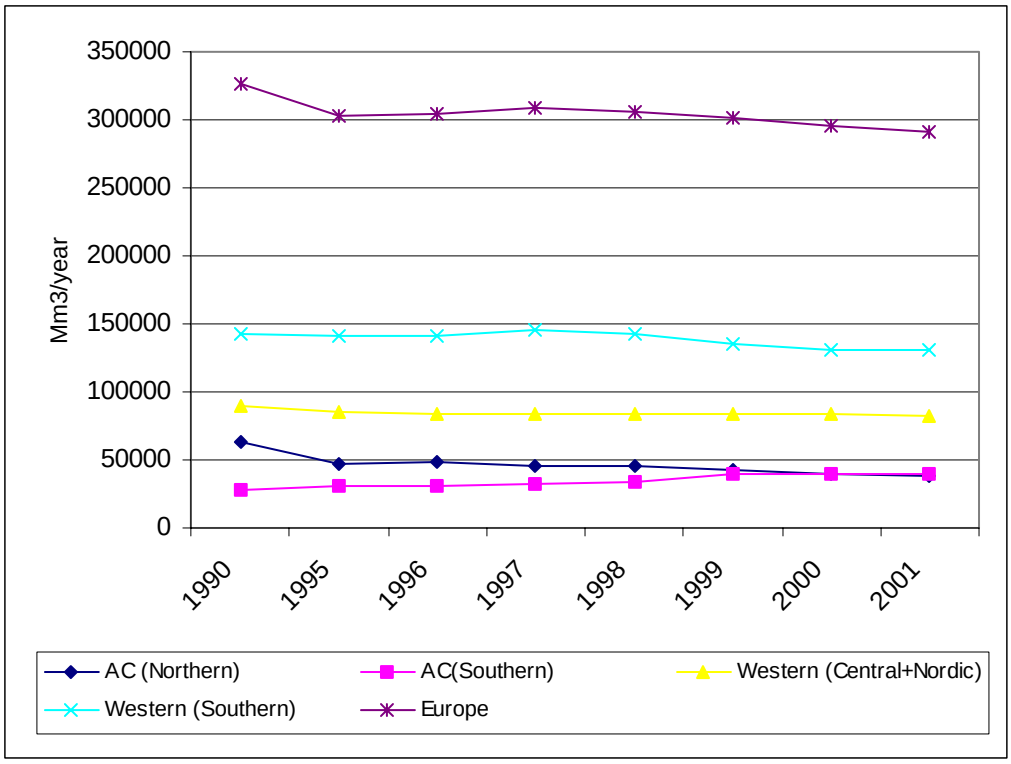
Total freshwater resources can show large variations along the time, as Figure 3 shows. Some of these variations are caused by variations in precipitation, but as Figure 4 shows, these are smaller (± 0.2 with respect to the long term average) in comparison to the variations in total freshwater resources (± 0.4 with respect to long term the average), which indicates the influence of variations in how to measure and estimate the internal flow and in the external inflow from countries. These differences make difficult the comparability of water stress indicators between countries, and in particular the Falkenmark indicator.

(WQ1b) Total water abstraction

Key Message

☺ Total water abstraction has decreased over the last decade in most regions of Europe with the exception of the southern Accession Countries where it has been increasing.

Figure 5: Trends in water abstraction for different European regions



Notes:

Western(Central+Nordic): Austria, Belgium, Denmark, Germany, Ireland, Luxembourg, Netherlands, UK, Finland, Sweden, Iceland, Norway
Western Southern: France, Greece, Italy, Portugal, Spain
Accession Countries (Northern): Bulgaria, Czech Rep. Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Rep., Slovenia
Accession Countries (Southern): Cyprus, Malta, Turkey
Data source: New Cronos (Eurostat, JQ2002)

Assessment:

Abstractions for different uses exert the most significant pressure on the quantity of freshwater resources. The total water abstraction in Europe is about 292 km^3/year, around 10 % of Europe's total freshwater resources.

Total water abstraction has decreased over the last decade in most regions of Europe with the exception of the southern Accession Countries where it has been a constantly increasing trend (from 28 520 to 39 972 Hm^3 /year between 1990 and 2001). This regional trend masks the decrease in total water abstractions, in Malta and Cyprus for the considered period. The regional increase is explained by the higher and increasing water abstractions in Turkey, mainly for irrigation purposes.

The most important decrease has occurred in the northern Accession Countries due to economic re-organisation, and in southern Western Europe, where France and Spain experienced a decreasing trend of water use for urban and irrigation purposes that can be explained by an improvement on water use efficiency.

References

Alcamo, J., Henrich, T., Rösch, T., 2000. World Water in 2025 – Global modelling and scenario analysis for the World Commission on Water for the 21st Century. Report A0002, Centre for Environmental System Research, University of Kassel, Germany.

Cosgrove, W. J. and F. Rijsberman, 2000. World Water Vision. Making water everybody's business. World Water Council. Earthscan, UK.

Hinrichsen, D., B. Robey, and U.D. Upadhyay. 1998. Solutions for a Water-Short World. Population Reports, Series M, No. 14. Baltimore, Maryland, U.S.A.: Johns Hopkins University School of Public Health, Population Information Program.

IPCC, 2001. The Regional Impacts of Climate Change. UNEP/WHO IPCC. http://www.grida.no/climate/ipcc/regional/

Lane, M., Kirshen, P. and Vogel, R.,1999. Indicators of impacts of global climate change on US water resources. J. Wat. Res. Plann and Mang. July-August.

Raskin, P., Gleick, P.H., Kirshen, P., Pontius, R. G. Jr and Strzepek, K. ,1997. Comprehensive assessment of the freshwater resources of the world. Stockholm Environmental Institute, Sweden.

Shiklomanov. Summary of the monograph "World water resources at the beginning of the 21st century" prepared in the framework of IHP Unesco.

Data

Spreadsheets:
Data on total freshwater resources:
WQ1_FreshWaterResources_Update03.xls
WQ1_Precipitation_Update03.xls
Data on total abstractions:
WQ1_TotalAbst_update03.xls
WEI indicator:
WQ1_WEI_update03.xls
WQ1_Water availability indicator:

WQ1_WaterAvailability_update03.xls

Meta data

Web presentation information

1. Abstract / description / teaser:

Gives ratio of mean annual total demand for fresh water to long-term average freshwater resources in EEA states, including trends in some European regions.

2. Policy issue / question:

Which areas in Europe are at higher risk of water stress?

3. EEA dissemination themes:

Water

4. DPSIR:

P

Technical information

5. Data source: New Cronos database (Eurosat JQ2002) for freshwater resources and abstractions
6. Description of data: Freshwater resources and total abstractions data in Mm^3/ year per year and country plus the long-term annual data provided by country.
7. Geographical coverage: EEA area plus Switzerland plus additional Mediterranean countries.
8. Temporal coverage: From 1970 onwards. The indicators have been developed from 1990, as there are large gaps of data from previous years.
9. Methodology and frequency of data collection: Yearly data requested.
10. Methodology of data manipulation, including making 'early estimates': Data estimation has been done by linear interpolation. If the gap is for on year only, it has been filled in with the nearest value. If there are no annual data for freshwater resources, the long-term annual data has been used.

Quality information

11. Strength and weakness (at data level): The data need to be considered with reservations due to the lack of a common European definitions and procedure to estimate water demands and consumption and freshwater resources. In addition, data are not available for all the countries considered, especially for the years 2000 and 2001, and data series from 1990 are not complete. Data at national level could not reflect water stress situations at local level. Current work is being carried out between EUROSTAT and EEA to standardise definitions and methodologies for data estimation.
12. Reliability, accuracy, robustness, uncertainty (at data level): Some cautions should be taken when comparing countries due to different definitions and procedures to estimate water use (e.g. some including cooling water other do not) and freshwater resources, in particular the internal flow.
13. Overall scoring (give 1 to 3 points: 1=no major problems, 3=major reservations):

Relevancy: 3

Accuracy: 1 (in particular for freshwater resources in some countries)

Comparability over time: 3 (long term freshwater resources require averaging over at least 20 years)

Comparability over space: 2

Further work required

1. Data and indicator level: It is necessary to have better indicators of the evolution of freshwater resources in each country (i.e. by using information of trends in discharges of some representative gauging stations per country). If groundwater abstractions are considered separate from surface water abstractions, it would be necessary to have some

indicators on the evolution of the groundwater resource (i.e. by using information on head levels of selected piezometers per country). Better estimates of water abstractions could be developed considering the uses involved in each economic sector.

2. Spatial level: There are notable differences between water uses in countries. Thus the assessment of the indicators should be based at national scale as a minimum requirement, although it would be preferable to have data at basin scale if available.