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Briefing Note

United Nations Educational, Scientific and Cultural Organization

World Water Assessment Programme

UN WATER

Monitoring Framework for Water

The System of Environmental-Economic Accounts for Water (SEEA-Water) and the International Recommendations for Water Statistics (IRWS)

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1. Introduction

The UN *World Water Development Report* (WWDR) series has reiterated the fact that our knowledge of water use is as poor as our knowledge of water resources – perhaps poorer. Information is largely incomplete or lacking altogether for some countries. Only limited disaggregated information exists, and the data that is available shows deficiencies in validity and homogeneity, and provides extremely poor information on trends. While the quality of information systems varies with each country, there are common difficulties, such as (WWDR3, Box 7.1, p. 97):

- Statistics on the magnitude of water abstractions are often estimated rather than based on data that are measured or collected from censuses and surveys. The level of uncertainty varies, but is particularly high for agriculture.
- Classifications of water users are not homogeneously defined and are not well disaggregated.
- Adequate historical datasets are rare, and the dates of available statistics are not always explicit.
- Lack of agreed terminology leads to discrepancies in data compilation and analyses.

It is against this backdrop that the UN World Water Assessment Programme (WWAP) reached out to the United Nations Statistics Division (UNSD) to produce a briefing note aiming for a better understanding of international methodological standards for water which have been developed by the international statistical community. This briefing note will help water professionals step outside the 'water box'[1] and take into account broader social, political and economic issues affecting the use and allocation of water resources (Figure 1).

2. Background

The System of Environmental-Economic Accounts for Water (SEEA-Water) and the International Recommendations for Water Statistics (IRWS), adopted in 2007 and 2010 respectively by the United Nations Statistical Commission (UNSC), provide the conceptual framework for monitoring progress towards water policy objectives in countries and on an international scale. SEEA-Water and IRWS are based on, and coherent with, the System of National Accounts (SNA), which has been in use for more than fifty years and has become a widely accepted international standard for monitoring economic policies.

1 The concept of the 'water box' is used in the third edition of the *World Water Development Report* (WWDR3) to describe the specific sphere (i.e. 'water sector') to which water management is confined.

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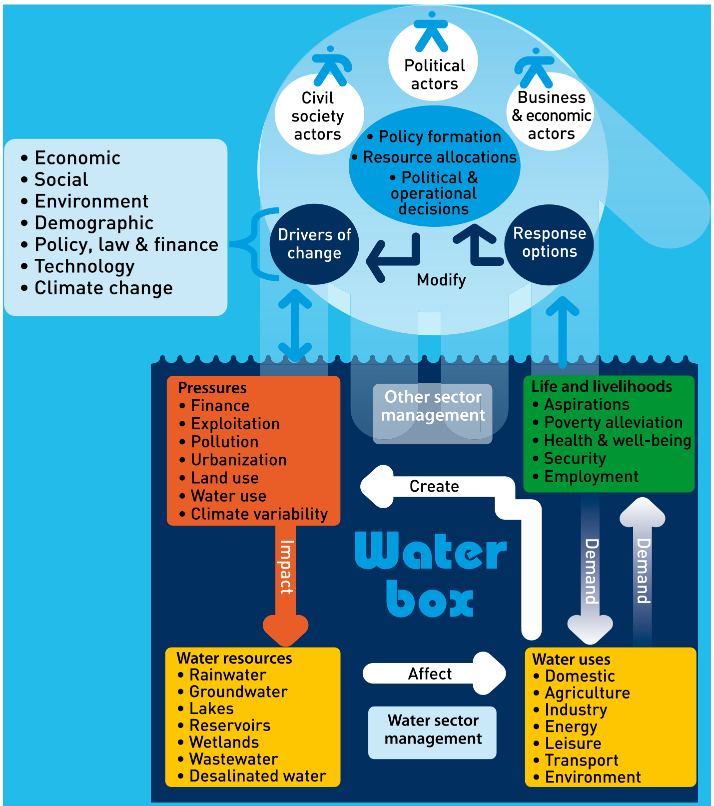
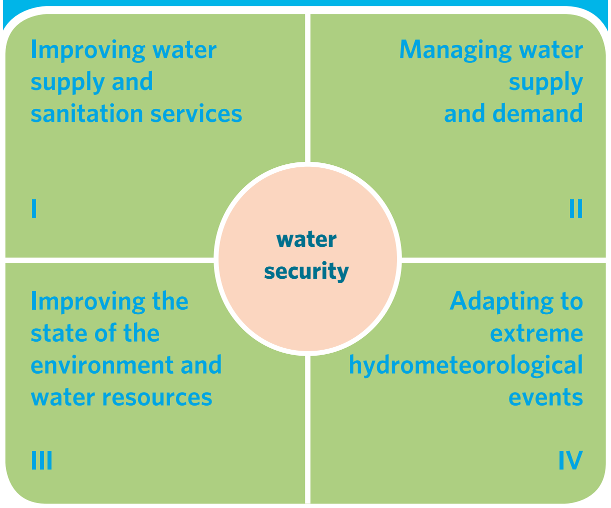
Figure 1. Decision-making affecting water



Source: WWAP (World Water Assessment Programme). 2009. *World Water Development Report 3: Water in a Changing World.* Paris/London, UNESCO/Earthscan, p. 5.

Figure 2. Broad grouping of water policy objectives



While SEEA-Water provides the conceptual framework for organizing water-related information including agreed concepts, definitions, classifications accounting rules and tables, the IRWS provides a list of data items and recommendations on the methods to compile them. Together they provide countries with important tools for developing and organizing water information. Although SEEA-Water and IRWS are relatively new, over fifty countries around the world are compiling or planning to compile water accounts. Increased use of the framework should lead to improvements in data quality and therefore better decisions affecting water. Water experts, policy-makers, statisticians and economists, among others, need to work together in order to make this happen.

3. The quadrants of water policy objectives

Water is essential for achieving equitable and sustainable social and economic development. Water security requires improving the management of water resources. This is a necessary condition for achieving many millennium development goals (MDGs), such as eradicating extreme poverty and hunger, achieving universal primary education, promoting gender equality and women's empowerment, reducing child mortality, improving maternal health, combating major disease, and ensuring environmental sustainability.

Policies to achieve water security have a different emphasis depending on the specific characteristics and needs of each society. However the overarching objectives can usually be framed within the four broad categories illustrated in Figure 2.

The first quadrant, *Improving water supply and sanitation services*, refers to all policies that aim to ensure the population has access to safe water as well as to means of disposing wastewater. Water supply and sanitation services are provided through water supply and sewer networks operated by water or sanitation utilities.

To improve water supply and sanitation services, it is necessary to monitor the quality and affordability of the services being offered to the population, as well as monitoring the progress being made towards expanding service coverage. The costs associated with providing the services in a sustainable way, including both current and capital costs, as well as the sources of financing them need to be taken into account. Efficient operation of the water utilities also needs to be monitored – they must be able to provide a reliable service to the population, recover the costs of providing the services, and reduce losses (due to leaks, theft, lack of a good registry of users and failure to bill and receive the payment of the bills).

The second quadrant, *Managing water supply and demand*,[2] refers to all policies that aim to improve water allocation in order to properly satisfy societal needs without compromising the needs of future generations or the environment. For this quadrant it is essential to monitor the amounts of water that are being allocated for different uses (including water allocated for environmental needs) and the losses during abstraction and distribution. It is also essential to measure the trade-offs in the

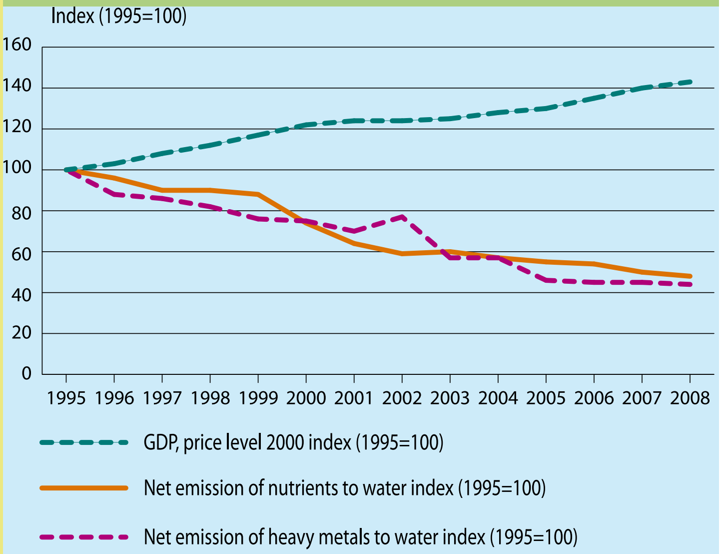
2 In national accounts the term 'supply and use' is commonplace, with a slightly different meaning to 'supply and demand'.

Implementation of water accounts in the Netherlands: Decoupling economic growth and water pollution

The Netherlands is a country with relatively abundant water resources. However, it faces a major challenge in terms of water pollution by nutrients and heavy metals. Further reductions in the emission intensity of production processes and decoupling between water emissions and economic growth are essential to guarantee good water quality for the country in the future.

Water accounts have been compiled in the Netherlands for several years and have helped the government to monitor progress in the implementation of water policies. The accounts show that pollution emissions to water courses have consistently decreased despite economic growth. In fact, there is decoupling between the net emissions to water and economic growth from 1995 to 2008, as shown in the figure to the right.

Economic growth and net emissions of pollution to water



Source: CBS Statistics Netherlands 2010. *Environmental Accounts of the Netherlands 2009*. The Hague/Heerlen, Statistics Netherlands.

Whereas the overall trend clearly demonstrates the decoupling between economic growth and net emission of pollution to water, the environmental accounts of the Netherlands 2010 also show that the emissions intensity (water emissions per euro of value added) differs significantly between industries over time. For example, in 2008, fisheries (ISIC 031) and water transport (ISIC 502) were responsible for relatively large emissions of heavy metals to water per euro of value added. The source of these emissions is the antifouling topcoat applied on the outside of sea-going vessels and fishing vessels. The highest nutrient intensity in 2008 was noted by the sewage and refuse disposal services (excluding sewage treatment plants' effluents) since these services include soil decontamination and the collection and processing of waste and wastewater produced by other industries that cause a lot of emissions to surface water.

allocation of water considering that water is a scarce resource and should be used sustainably. Productivity of water is key when deciding water allocation. Furthermore, it is important to take into account the financial resources necessary to maintain or increase the capacity to supply water through investments in storage, conveying and reclamation systems.

The third quadrant, *Improving the state of the environment and water resources*, refers to those policies that aim to preserve or improve the quality of water resources and aquatic ecosystems. In this quadrant it is essential to measure the emissions discharged into water resources by different users, the capacity of wastewater treatment facilities to remove them, and the carrying capacity of the different water bodies. Investments in sanitation infrastructure and its financing play an important role in strengthening and further enhancing the mechanisms to reduce waterborne emissions.

The fourth quadrant, *Adapting to extreme hydrometeorological events*, refers to those policies that aim to reduce the socio-economic impact of water related disasters. In this quadrant it is important to identify the variability in water availability that gives rise to droughts and floods. It is essential to monitor the state of natural systems (e.g. floodplains, marshlands) or man-made structures (e.g. levees, dams) that will assist in regulating seasonal and inter-seasonal variations.

In order to measure progress towards the achievement of the goals set out in each of the four quadrants described above, an integrated system is required. These systems will assist with collecting data and converting it into information for benchmarking, monitoring progress and identifying trends.

Hydrometeorological data is only a subset of the data required to understand today's water issues. Data from many other fields of expertise are necessary to understand the complex interrelationships of water with aspects of human well-being. Data must be integrated, analyzed and converted into useful information for policy-makers, the general public, managers and researchers.[3] Due to the nature of water, a wide variety of measures are necessary in order to understand the various ramifications of the decisions that are made. It is therefore necessary to have a comprehensive conceptual framework to guide the process of data integration and its transformation into policy relevant information. SEEA-Water is the conceptual framework adopted by the United Nations (UN) for this purpose.

3 WWAP (World Water Assessment Programme). 2006. *World Water Development Report 2: Water: A Shared Responsibility*. Paris/New York, UNESCO/Berghahn Books.

4. Building on the System of National Accounts, the international monitoring framework for the economy

Economic policies are monitored using indicators which are widely accepted and can be compared between countries and over time. Most of these indicators, such as the gross domestic product (GDP), are derived from the standard concepts and definitions prescribed in the SNA. The SNA is an internationally agreed standard adopted through a rigorous intergovernmental process in the UN. Its first version was adopted in 1953 and the latest version in 2008. Today it is the main source of information for internationally comparable economic indicators and for economic analysis and modelling. Countries around the world have developed the capacity to systematically compile the accounts in their National Statistics Offices and/or Central Banks.

Based on a process similar to that which led to the adoption of the SNA, the UNSD – in collaboration with Eurostat, the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD) and the World Bank, as well as experts from different countries – developed the System of Environmental-Economic Accounts (SEEA). SEEA provides internationally agreed standards for the compilation of measures about the environment and its interactions with the economy.

A subsystem of SEEA is SEEA-Water, which was developed to provide a conceptual framework to support water policy design and evaluation. It integrates physical and monetary data that describe the natural water cycle and its interaction with the economy. Being a subsystem of SEEA, the framework will facilitate evaluation of how water resources interact with other natural resources, as well as ecosystem services.

SEEA-Water builds upon the existing SNA and SEEA frameworks. It ensures the coherence of environmental and economic statistics, hence facilitating and improving analysis of the interrelations between the environment and the economy. The framework contains a series of identities (e.g. those involving supply and use), which can be used to check the consistency of data, with the advantage of improving basic statistics.

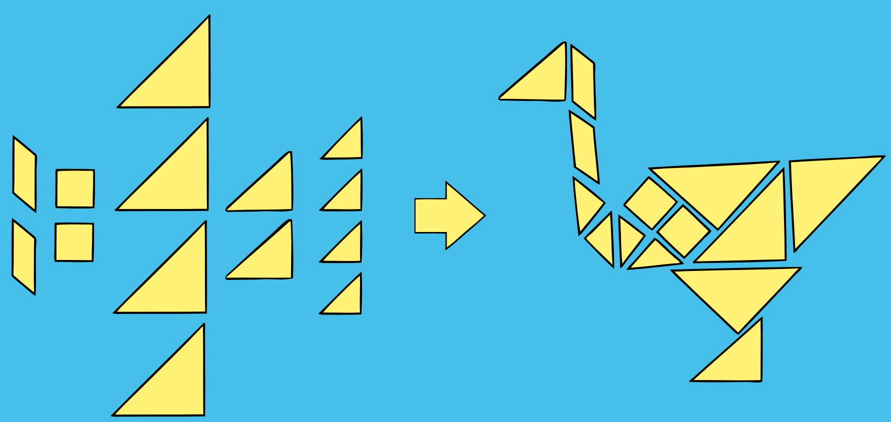
The framework allows for the calculation of coherent sets of indicators, which are precisely defined, consistent and interlinked with each other because they are derived from a fully consistent data system instead of loose sets of independently calculated indicators.

Figure 3 illustrates the transition from environmental statistics to environmental accounts. Whereas statistics provide different sets of data which inform specific parts (e.g. water in agriculture, water supply, etc.), accounts integrate the parts and provide a coherent 'image' that emphasizes the relationships between the different elements of a complex system. Moreover, data gaps and overlaps can be identified and remedies put in place.

SEEA-Water is a conceptual framework for the integration of information related to water and the economy, coherent with the SNA. SEEA-Water is based on a systems approach, which concentrates on measuring all the 'stocks' and 'flows' relevant to water policy-making. Similarly, other subsystems of the SEEA are being developed for other resources, such as, energy and fisheries and specific sectors (e.g agriculture).

Figure 3. From statistics to accounts

The System of Environment-Economic Accounts for Water (SEEA-Water) is a conceptual framework for the integration of information related to water and the economy, coherent with the System of National Accounts (SNA).



SEEA-Water is based on a systems approach, which concentrates on measuring all the 'stocks' and 'flows' relevant to water policy making.

Environment Statistics

Environmental Accounts

SEEA-Water was adopted by the UNSC in 2007. The UNSC brings together the chief statisticians from Member States and is the highest decision-making body for international statistical activities, especially the setting of statistical standards, the development of concepts and methods and their implementation at the national and international level. The UNSC is a functional commission of the United Nations Economic and Social Council (ECOSOC).

As part of the implementation of the framework, IRWS was developed as an agreed set of recommendations for compiling internationally comparable information related to water. The recommendations provide an agreed list of data items to support the collection, compilation and dissemination of water statistics, as well as their integration into water accounts. IRWS was adopted by the UNSC in February 2010.

SEEA-Water and IRWS can be implemented in countries which are at various stages of development. They offer a statistical organizational framework for integrating data from different sources (e.g. admistrative, surveys, etc.), deriving a coherent set of macro aggregates useful for modeling. The integration of the data adds value to the individual data sets.

5. Water accounts and statistics in detail

SEEA-Water provides a set of recommendations for creating integrated information systems to study the policy-relevant impacts of the use and development of water resources. It offers a conceptual framework based on a systemic or integrated perspective of water resources management. In this model, the economy and the inland water resources are identified as two subsystems within which water cycles, while maintaining its interaction with the larger atmospheric and oceanic systems.

The economy of a given territory or country comprises enterprises, government agencies and households, which undertake activities of production, consumption and accumulation. In doing so they use water in different ways. They can physically remove water from the environment for production and consumption or use water without physically removing it from the environment.

The inland water resource system of a given territory – which can be a country, an administrative region or a river basin – comprises three main media: (a) surface waters, which include rivers, lakes,

Table 1. Simplified breakdown of economic activities and households, which are of main interest for water management

ISIC codes	Description of the economic activity	Relevance for water policy and management
1-3	Agriculture, forestry and fishing.	The largest amounts of water are abstracted ('consumptive' or 'off-stream') from inland water resources for these economic activities. It is important to distinguish water abstracted from surface and groundwater sources ('blue water'), and water abstracted from the 'soil water' ('green water').
5-33, 41-43 38, 39, 45-99	Manufacturing, mining and quarrying and other industrial activities. Service activities.	These economic activities abstract water directly from inland water resources or, more often, through municipal water networks (classified as ISIC-36). They are also important contributors to waterborne emissions.
35	Electric power generation, transmission and distribution.	It is useful to identify the following division: (a) hydroelectricity, where the potential energy of water is used to move turbines ('non-consumptive' or 'on-stream' use); and (b) other types of generation, where water is used for cooling ('consumptive' or 'off-stream' use). Hydropower generation requires a large amount of water, even though it is returned to the river without being 'consumed'. Large amounts of water are also used for cooling thermoelectric generators, including nuclear power plants.
36	Water collection, treatment and supply.	This economic activity refers to the water abstracted, possibly treated and supplied through mains to industries and households. Establishments can be owned and/or managed by public or private entities.
37	Sewerage, including treatment of wastewater.	This activity is often done in conjunction with ISIC 36. Sewage is collected through municipal networks, which may or may not treat the water in wastewater treatment facilities before returning it to the environment.
No code	Households as consumers.	Households usually receive water from water utilities (ISIC-36) and return wastewater through sewerage utilities (ISIC 37).

Table 2. Examples of indicators for each of the four groups of water policy objectives

Group of water policy objectives	Examples of policy relevant information
I. Improving water supply and sanitation services	• Population using improved water sources • Population using improved sanitation facilities • Fixed capital formation for ISIC 36 and 37 (SEEA-Water national expenditure tables)
II. Managing water supply and demand	• Relative water stress calculated as the sum of abstractions for 'consumptive' uses divided by net precipitation (SEEA-Water physical supply and use tables and asset accounts) • Value added per unit of water used by industry (SEEA-Water hybrid table) • Percentage of losses in the different supply systems
III. Mitigating environmental degradation of water resources	• Ratio of treated wastewater returns to total wastewater returns to the environment (SEEA-Water physical supply table) • Ratio of net emissions to gross emissions by type of industry, measured by weight units of biochemical oxygen demand (BOD) and chemical oxygen demand (COD) (SEEA-Water gross and net emissions tables) • Value added per unit of BOD or COD discharged (SEEA-Water hybrid accounts)
IV. Adapting to extreme hydrometeorological events	• Time series showing precipitation and evapotranspiration patterns (from SEEA-Water asset accounts) • Stocks of water at different points in time (asset accounts) • Capital formation for managing water resources (SEEA-Water hybrid accounts)

Implementation of water accounts in Mauritius: Water scarcity in a rainy country

Mauritius is a small island country located in Africa, 800 km off the east coast of Madagascar. Even though the average precipitation in the country is nearly 2 000 mm per year, most of it is concentrated in only six months of the year. The runoff flows quickly to the sea through its short rivers. The capacity of the dams in the country is equivalent to only 3 per cent of the total annual runoff.

On the other hand, the population density in Mauritius is very high (608 inhabitants/km^2) – more than twice the population density of the United Kingdom – which means there is a lot of pressure on all natural resources. The economy of Mauritius has grown very rapidly. The GDP has almost tripled in the last 20 years. All of these factors have contributed to creating a situation of high water stress in the country.

The Central Statistics Office (CSO) and the Water Resources Unit (WRU) of Mauritius have worked together to prepare preliminary water accounts and statistics, using the SEEA-Water and IRWS framework, in order to monitor the water policies being implemented which respond to current and future water challenges.

Most of the economic activities in the country (except agriculture and electricity) use water supplied by water utilities (industry classified as ISIC 36), which have considerable losses due to ageing infrastructure. The table below shows some key indicators derived from the information gathered.

The indicators are calculated according to the SEEA-Water and IRWS concepts and definitions, which guarantees coherence and comparability of the information in order to correctly inform policy-makers. As this work progresses, additional indicators including economic aspects can be derived from the water accounts.

Key indicators for water supply and losses in economic activities in Mauritius

Indicator	Units	2005	2006	2007	2008	2009
Water abstractions by water utilities (ISIC 36) per capita per day	L/person/day	442	421	460	465	486
Losses (including theft, and unbilled water)	%	52	50	54	55	55
Water supplied to households per capita per day	L/person/day	167	158	167	163	166

Source: Based on CSO (Central Statistics Office). 2010. *Digest of Energy and Water Statistics 2009*. Republic of Mauritius, Ministry of Finance and Economic Development.

reservoirs, snow and ice; (b) groundwater, which refers to the aquifers; and (c) soil water, which is a transient state between surface and groundwater useful when accounting for water used in rain-fed agriculture).

Economic activities are classified according to the International Standard Industrial Classification of All Economic Activities (ISIC), which has been used since 1948. Indicators such as value added, production, national income, employment, population and others are generated by ISIC classes.

ISIC covers all economic activities, ranging from agriculture to retail sales to water collection, treatment and supply and sewerage and wastewater treatment services. ISIC classes are mutually exclusive and comprehensive and include a precise description of the coverage. Table 1 shows a breakdown of the main industries which are of interest to water resources management and their relationship with ISIC. Different countries will seek different levels of disaggregation of data according to their own water policies.

Based on the classification for the inland water system and economy described above, the framework provides specific guidelines for the data items to compile, such as water abstractions by industry and by source (i.e. surface water or groundwater), water returns, gross and net emissions of pollutants, and monetary transactions (e.g. fees, permits, investment in hydraulic infrastructure, etc.). Because the structure of the physical accounts mirrors that of the monetary accounts, it is possible to combine physical and monetary information in the so-called hybrid accounts. The hybrid account is one of the most important features of SEEA-Water as they combine information such as fixed capital formation for the water sector, value added by each industry, fees, permits, taxes and subsidies with information on water abstractions, water consumption and emissions of pollutants.

Many indicators can be derived from the framework, from the commonly used physical indicators, such as total renewable water resources and water stress, to those indicators that combine physical and monetary information, such as water productivity by economic activity (value added divided by water use). The derived indicators have very precise definitions and are therefore comparable over time and space.

6. Linking water accounts and statistics with policy objectives

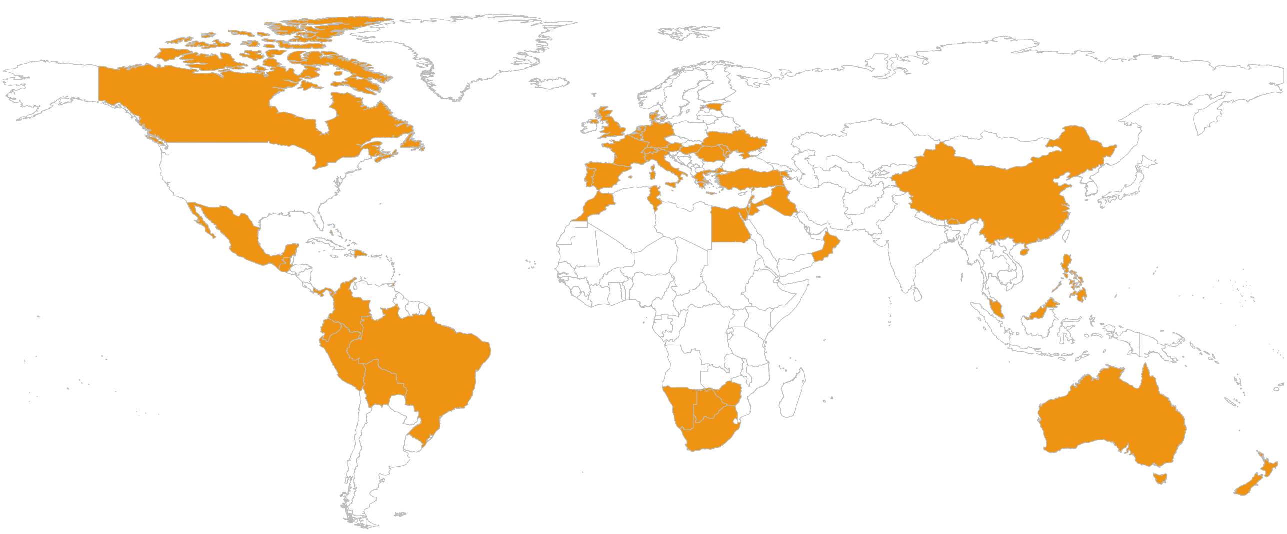
The main purpose of compiling water accounts and statistics is to identify areas of social, economic or environmental stress, and to monitor relevant policies. The four quadrants described above provide guidance for how to organize targets to achieve water security in a broad sense. For each of the quadrants it is possible to identify indicators derived from water accounts and statistics. SEEA-Water and IRWS provide the concepts and definitions for constructing the indicators, some examples of which are shown in Table 2. A full collection of indicators is presented in the annexes to SEEA-Water and IRWS, along with the formulas to calculate them from standard tables or data items.

Since SEEA-Water and IRWS are consistent with the SNA, it is also possible to monitor the contribution of water to policies that go beyond the four quadrants of water security. Water accounts and statistics are a means of linking the decisions that are within the 'water box' to decisions that are 'outside the box'.

7. Implementation at a national and an international level

Experience in countries has shown that water accounts compiled according to SEEA-Water and IRWS can be integrated with existing data or data estimated through known parameters. They simply aid in integrating all the data from different sources to improve understanding of the different aspects of water

Figure 4. Countries compiling or planning to compile water accounts (non-exhaustive)



Implementation of water accounts in Mexico: A preliminary assessment of water productivity

Mexico has the infrastructure to irrigate nearly 6 million hectares of cropland. Approximately 77 per cent of inland water resources abstracted in the country (excluding hydroelectricity) are used in agricultural activities (classified as ISIC 1-3), which contribute to 3.6 per cent of the country's GDP. In several parts of the country the growing demands for water in cities compete with existing uses, such as agriculture and environmental water requirements.

Several aquifers are overexploited, which means that the abstraction rate is higher than the renewal rate. The volumes of surface water allocated through permits in several watersheds are larger than the total renewable flow, causing unreliable access to freshwater by the different economic activities.

Through different programmes, the government of Mexico has promoted more efficient use of water. The actions have included the modernization of irrigation districts, the establishment of water markets which allow users to exchange water permits, and fees are charged for the amount of water abstracted from inland water resources.

The National Institute of Statistics and Geography (INEGI) and the National Water Commission of Mexico (CONAGUA) have worked together to compile preliminary water accounts which are useful for monitoring the changes occurring through the years. The following preliminary table shows the productivity of water for some of the main activities that abstract inland water resources (excluding hydroelectricity). The productivity is calculated as the ratio of value added per cubic metre of water abstracted.

Some modest, but significant increases in productivity can be observed. Further analysis is needed in order to have a more detailed identification of the productivity of water for each type of industry.

Value added per volume of water abstracted (pesos/m^3, using 2003 prices)

Industry	2003	2004	2005	2006	2007	2008
Agriculture (ISIC 1-3)	4.69	4.78	4.65	4.77	4.93	4.98
Drinking water supply and sanitation (ISIC 36 and 37)	1.46	1.43	1.47	1.96	1.52	1.55
Thermoelectricity (ISIC 35)	17.0	17.3	17.5	19.7	21.1	19.7
All other industries	1482	1545	1679	1718	1696	1673

Source: Calculated from INEGI (Instituto Nacional de Geografía y Estadística). 2010. *The Economic and Ecological Accounts of Mexico 2003–2008*, Mexico, INEGI, p. 29.

resources thus facilitating the exchange of information in support of decision-making. Initially, the data used to compile the accounts may not be of the quality desired. As water accounts become a systematic way of organizing information, it is expected that more accurate and integrated data become available.

An important contribution of water accounts is that it has shown to improve communication between national accountants and water experts by using common language, agreed concepts and definitions. It has built a bridge between the water community and the statistical community to obtain a policy relevant information system for water.

Water accounts require, and therefore facilitate, institutional arrangements that foster collaboration between producers and users of information. They usually require the involvement of the National Statistics Office and/or the Central Bank, as well as the ministry or agency in charge of water resources or the environment, and the different agencies with tasks related to water management and water utilities, irrigation companies or farmer associations, electricity companies, etc. SEEA-Water provides the framework necessary to make the collaboration successful, by identifying the key data sources and providing common terminology, concepts and definitions. Key to the sustainability of the SEEA-Water compilation is the understanding of the added value of integrating the information in a common framework to better inform decision-making.

Over time, increased use of the framework should lead to improvements in the availability and quality of the data and the information base that supports the development and assessment of policies which affect water.

As the framework is more widely implemented at national and subnational levels, it will become easier to share and compare information over time and space.

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