



Disambiguation of water use statistics¹

Amit Kohli, Karen Frenken, Cecilia Spottorno
23 September 2010

1. Introduction

Water statistics at all levels are crucial for sustainable development and management. They shape policy, decision-making, and act as a proxy for development. Integrated Water Resources Management (IWRM) plans around basic information on water resources and use. Unfortunately, the nomenclature surrounding water information is often confusing and gives rise to different interpretations and thus confusion. When discussing the way in which renewable water resources are utilized, the terms water use, withdrawal, consumption, abstraction, extraction, utilization, supply and demand are often used without clearly stating what is meant.

This note attempts to shed light on how the AQUASTAT programme defines these terms, although readers should be aware that these definitions are not globally standardized. Harmonization efforts within the UN system are ongoing.

2. Water use categories

Water use is a *general, non-specific term* that describes any action through which water provides a service. In AQUASTAT, “water use” is synonymous with “water utilization”. This section describes the different types of uses, and therefore the water categories.

In-stream and off-stream water use

In-stream water use refers to surface water resources and does not involve withdrawal as the use is provided directly in the river or lake in question. Some examples of in-stream water use are navigation, hydropower generation, pollution dilution, tourism, freshwater capture fisheries and ecosystem maintenance.

Off-stream water use is called “withdrawal” and is covered in detail in section 4.

Consumptive and non-consumptive water use

Consumptive water use implies a substantial reduction in the quantity or quality of the water that returns to the system after being withdrawn. The concept of water consumption is further explained in section 5, but mostly refers to evaporative losses.

Non-consumptive water use does not substantially change the withdrawn water, almost all of it returning to the system, although a “substantial change” might be defined differently in different countries. Also most in-stream water uses are non-consumptive.

Anthropogenic and natural water use

In policy-making, water use is frequently framed in a social, economic or political setting. Therefore, it is common to think how water serves society. However, water also provides for natural uses (which of course also have value to society, albeit indirectly). Some natural water uses include nutrient cycling, defence against saline intrusion, and meeting ecosystem needs. These natural water uses are not covered in greater detail in this article, since AQUASTAT focuses on withdrawn water.

¹ The AQUASTAT Programme of FAO collects, analyzes and disseminates information on water resources, water uses, and agricultural water management. Water withdrawal time series per country can be observed in the [AQUASTAT database](#) (see reference for link). Questions and comments can be directed to aquastat@fao.org.

Freshwater, brackish water and saltwater use

One way to classify a water source is by its salt concentration. Water may have salt content for various reasons, including influence of ocean currents due to coastal tidal flows or saltwater intrusion, naturally occurring salt formations or situations where a large amount of water evaporates, leaving behind salts (for example, endorheic basins, irrigation without adequate drainage, etc). Since AQUASTAT focuses on freshwater, ocean water withdrawals are not included in the data provided in the database.

3. The AQUASTAT system

This section describes the methodology used by AQUASTAT. International statistics collected by other organizations might be different.

AQUASTAT reports water withdrawals measured at the point of withdrawal, not at the point of delivery (see section 4).

Water withdrawal “by source” and “by sector” are two variables in the AQUASTAT database that provide different views of the same water withdrawal data. Water withdrawal by source includes “primary freshwater resources” (renewable freshwater that has not been withdrawn before and fossil freshwater resources) and non-conventional sources of water, which consist of “secondary freshwater sources” (reused treated wastewater and reused agricultural drainage water) and desalinated water. The difference between total water withdrawal by sector and total freshwater withdrawal (surface water + groundwater) is desalinated water, which is not a renewable freshwater resource. This distinction is made in AQUASTAT, because water withdrawal information is rarely disaggregated by source and by sector in the countries of interest. Section 4 elaborates more in detail on water withdrawals.

In order to balance simplicity and thoroughness, AQUASTAT has aggregated all water uses into three sectors: agricultural, municipal and industrial. Domestic water withdrawal is considered to be a subset of municipal water withdrawal (Table 1). These categories have been created in consideration of the information available from most countries. A major factor that determines the category in the AQUASTAT database is whether the water is provided by a network or withdrawn by the water user (self-supplied). Table 1 illustrates how the different categories are aggregated into AQUASTAT’s three sectors. This table is only provided to explain AQUASTAT’s statistics, it does not represent a recommended approach to categorizing water withdrawals. An explanation of the AQUASTAT sectors is given below.

Agricultural water withdrawal

Agricultural water withdrawal considers self-supplied irrigation and livestock watering requirements. Water for the dairy and meat industries and industrial processing of harvested agricultural products is included under industrial water withdrawal, as they are industries. Unfortunately, agricultural water withdrawal information obtained by AQUASTAT frequently includes domestic water requirements of rural populations. See Table 1 for AQUASTAT aggregation criteria.

Municipal water withdrawal

Municipal water withdrawal implies water that is provided by the public network system. In the interest of clarification, municipal water withdrawal includes domestic water withdrawal, which is mainly used for drinking, cooking and cleaning, and has a very low consumption rate. But because of its availability, municipal water in general is also used for urban industry, urban landscaping (including gardens) or urban irrigated agriculture. This aggregation is selected due to the fact that this information is more readily available in the countries monitored by AQUASTAT (Africa, Asia, Latin America and the Caribbean).

Industrial water withdrawal

Industrial water withdrawal in AQUASTAT only includes the withdrawals that are self-supplied. Industries supplied by the public water network are included under municipal (see above) in order to not double count the water withdrawal.

TABLE 1
Aggregation methodology in the AQUASTAT database

AQUASTAT sectors	Water use category	Self-supplied / Network
Agricultural water withdrawal	Irrigation	Self-supplied
	Livestock	
	Aquaculture	
Municipal water withdrawal	Domestic	Network
	Irrigation	
	Livestock	
	Industrial	
	Thermoelectric	
	Mining	
	Commercial	
Municipal water withdrawal if explicitly stated, else agricultural water withdrawal	Domestic	Self-supplied
	Commercial	
Industrial water withdrawal	Industrial	Self-supplied
	Thermoelectric	
	Mining	
NOT counted	Hydroelectric	
	Recreation	
	Freshwater capture fisheries	
	Navigation	

4. Water withdrawal

Withdrawn water is *water removed from its source for a specific use*. Water withdrawal can also be called “water abstraction” or “water extraction”. It is important to note that water sources are frequently far from where water is needed, which requires the water to be removed from the source (i.e. withdrawn) and transported to where it is needed. The point at which the water is extracted (either the pump or the intake of a canal) is called the “point of withdrawal” or “source”, while the location where the water is needed is referred to as the “point of delivery” or “point of use”. The difference in the quantity of water between the point of withdrawal and the point of delivery can be quite significant, between 20 to 30 percent of the amount withdrawn (Cheong, 1991), but can exceed 60 percent (ADB, 2003). These losses are sometimes called “non-revenue water” (NRW), and consist of leaks, flawed meter readings, operator error, and/or illegal connections. Of course, if the water is used close to the point of withdrawal, this difference becomes less important (for example, the case of self-abstracted industrial water withdrawal).

Water withdrawal is composed of the following categories:

- Primary renewable freshwater resources (not withdrawn before)
 - Primary surface water
 - Primary groundwater
- Primary freshwater resources
 - Fossil groundwater
- Non-conventional water sources
 - Secondary freshwater sources (previously withdrawn and returned)
 - Reused treated wastewater
 - Reused agricultural drainage water
 - Desalinated water (not included in freshwater withdrawal by source)

Total water withdrawal values have two basic aggregation methods, by source or by sector, and this information is relevant to different user groups.

Water withdrawal by source

“Water withdrawal by source” is important for hydrologists and water resources managers, since they need to understand where water is coming from and where it’s going.

Withdrawn water that is returned to a water body and reused downstream is more important when considering water consumption than water withdrawal, discussed in section 5.

Water withdrawal by sector

“Water withdrawal by sector” is important for urban planners, economists, and politicians. Unfortunately, the large variety of water users within the economy can be quite overwhelming. Luckily there are some standardization systems, for example the International Standard Industrial Classification (ISIC) wherein each specific sector (user group) has a code assigned to it. Theoretically, this system provides an international baseline on which to make comparisons (UNSD, 2010), but this depends on the information-gathering capacity in different countries. Additionally, depending on the data user, reporting statistics at this level of disaggregation might be inappropriately complex. As previously discussed, in AQUASTAT the sector categories are agricultural, municipal, and industrial.

5. Water consumption

Not all uses of water consume water, and some water consumptions are not ever withdrawn. Water is consumed when a part of the water evaporates or becomes contaminated. AQUASTAT does not consider water delivery system leaks as consumptive. Some cases regarding water consumption are presented below.

Agricultural water

The clearest example of consumptive water use is agriculture. Globally, around 50 percent of the water withdrawn for agriculture is consumed through evapotranspiration. Agriculture is responsible for approximately 70 percent of water withdrawals, but 90 percent of the water consumption.

Aquaculture and inland fisheries

Aquaculture is an off-stream use, sometimes (but not necessarily) combined with irrigated crops like rice, whereas inland capture fisheries are an in-stream use. Rivers and/or natural lakes surface areas are not modified in order to perform inland fishing and therefore this water use is neither a withdrawal nor a water consumption. Since aquaculture is sometimes performed in areas where no water was before, there is both water withdrawal and water consumption. However, care must be taken to not double-count this water consumption if it is already included in coexisting agriculture.

Municipal water

Some water consumption can be expected from urban industry, urban landscaping, and urban irrigated agriculture (especially in the latter two), categories that fall under municipal water. The exact consumptive rate depends on several factors, for example, the amount of green spaces, weather, and socioeconomic status of urban communities will affect the rate of water consumption.

Industrial water

Industry contains a wide variety of water users and as such includes sub-sectors with very high and very low water consumptions. Two of the more interesting sub-sectors of industry are presented below.

Hydroelectric plants

Water is used in-stream to generate electricity, therefore there is no water withdrawal, and should not be included in any withdrawal numbers. That being said, hydroelectric plants consume water if an artificial reservoir was built upstream. This is because reservoirs substantially increase the surface area of the water body, and in so doing, they increase the evaporation expected from that body of water. For example, the Aswan dam in Egypt has a capacity of 169 km³ and the average long-term annual natural flow into the lake is 84 km³/year, but 10 km³/year is lost in evaporation (FAO-AQUASTAT, 2010). These 10 km³ would not be lost every year from the Nile River if it were not for the reservoir. Therefore the dam represents a consumptive use.

Cooling water requirements in thermoelectric plants

Depending on the cooling system employed (once-through or closed-loop system), thermoelectric power plants will either have a high withdrawal with a low consumptive use rate, or a low withdrawal with a relatively high consumptive use rate. In both cases, the consumption is in the same order of magnitude, 1-3 m³/MWh (EPRI, 2002), without accounting for plant efficiency or specific climatic conditions.

6. Conclusions

In order to maximize the transparency of texts, reported data, and communications, care should be taken to understand the differences between water use, water withdrawal (or water abstraction), water consumption, and what the categories represent. The increased cost of adequate tracking of statistics is more than offset by the increased understanding and control policy- and decision-makers have over the water resources.

References

- **ADB [Asian Development Bank]**. 2003. *Asian water supplies, reaching the urban poor*.
- **Cheong, L.C.** 1991. Unaccounted-for water and the economics of leak detection. *Proceedings of the International Water Supply Congress and Exhibition, Copenhagen*, Water supply, Volume 9.
- **EPRI [Electric Power Research Institute]**. 2002. *Water & sustainability (Volume 3): US water consumption for power production — The next half century*. Palo Alto, CA (USA).
- **FAO**. 2010. *AQUASTAT*. <http://www.fao.org/nr/aquastat>. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 05/07/2010.
- **UNSD [United Nations Statistics Division]**. 2010. *International Recommendations for Water Statistics*.