FAO AQUASTAT Information

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FAO AQUASTAT

FAO AQUASTAT is the FAO's global information system on water and agriculture. It provides data for countries in Africa, Asia, Latin America, and the Caribbean, with a special emphasis on agricultural and irrigation water use.

AQUASTAT produces country profiles with general information on the geographical and economic situation of each country, and more detailed information on surface water and groundwater resources, water use, and water management. The aim is to describe the particularities of the country and problems relating to the development of the water resources and, in particular, irrigation. There is information on irrigation trends; existing policies and legislation relating to water use in agriculture; possible treaties and agreements between countries; and prospects for water management in agriculture are presented.

AQUASTAT Data - Sources and Analysis

The AQUASTAT Main Database reports water statistics at a country level, with a special emphasis on irrigation and agricultural water. The AQUASTAT data are collected and reported by various national and international agencies, but mostly from national government statistics offices and water and agricultural authorities. AQUASTAT collates this information by annual questionnaires sent to national correspondents in each country.

The statistics are based on the best available data and analysis techniques, and are rigorously validated to check their source and ensure internal accuracy. However, their accuracy and comprehensiveness depend on the data collected and reported by the national and international agencies. There are a number of data gaps for many countries, and these gaps are often worse for groundwater, because groundwater use is more difficult to measure directly than surface water use. This is especially the case for agriculture, as large scale irrigation schemes, which are easier to

measure, are usually based on surface water. By contrast, groundwater-based irrigation and other agricultural use in Africa is dominantly small-scale and managed by individual farmers or communities, and so is very difficult to measure and record. AQUASTAT uses modelling to fill in some of these data gaps. It should be recognised that these modelled data may not be accurate.

The data are updated at different frequencies, for example:

- Water resources data are long-term average annual values, which remain the same over the years. A comprehensive review was done in 2014.
- Water use data for Africa are updated at intervals of between 1 and 10 years, depending on data availability, which is checked at least every 5 years for each country, and with a thorough update (full dataset) every 10 years together with the country profile update.
- Some specific data categories are updated in collaboration with other agencies, as and when data become available, such as: access to improved drinking water source sub-category data are provided by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation.

Using AQUASTAT Data for Groundwater Assessment

Some key FAO AQUASTAT groundwater and other water statistics are included in the country pages in this Atlas. These statistics provide a very useful overview of the extent of groundwater resources and use in each country, compared to surface water resources, and allow comparison between countries.

However, it should be recognised that these data are not comprehensive, and cannot give a complete picture of groundwater use. In particular, keep in mind the following:

-AQUASTAT does not include any information on domestic water use from distributed water sources - e.g. boreholes/tubewells, dug wells or springs. In much of Africa, this is the main use of groundwater - traditionally in rural areas, and increasingly in urban areas.

- The date of the statistic. Older data may now be out of date.

- Groundwater recharge is much more difficult to quantify than surface water flows. Recharge ('groundwater produced internally' in AQUASTAT) is not measured directly but is estimated as a percentage of annual rainfall (in arid countries) or by estimates of river base flow made from river flow/level data (for humid countries). This is a crude way of estimating recharge, which is also impacted by hydrogeological factors such as aquifer permeability and storage, and the presence of superficial deposits. For many countries in Africa, a lack of high resolution river data and rainfall data means that the recharge estimates may be based on relatively few datapoints. This means that it is not possible to be very confident about how reliable the groundwater recharge statistics are.

- The volume of groundwater stored in, and flowing through, aquifers (i.e., groundwater resources) is hidden below the ground, and is therefore far more difficult to measure than surface water stores (e.g. in lakes and rivers). The AQUASTAT variables for renewable groundwater resources are based on the national scale recharge estimates, on estimates of groundwater stored in aquifers in the country, and in some cases on estimates of groundwater flowing into the country from aquifers outside it. In many countries in Africa there is a lack of the hydrogeological data needed to make reliable estimations of groundwater storage and flow

in aquifers - such as aquifer characteristics and groundwater levels. This means that many of the estimates must be made based on relatively few datapoints. Also, and partly because of this, the estimation methods vary from country to country. Altogether, this means that it is not possible to be very confident about how reliable the groundwater resources statistics are, and it may not be possible to confidently compare data between countries.

- Most groundwater abstraction points in Africa are small-scale and widely dispersed, from millions of low-yielding boreholes and hand-dug wells. Most groundwater abstraction from these points is not measured. There are fewer large-scale groundwater abstractions in much of Africa, most of which are for industry, agriculture or municipal use. Abstractions for municipal use are likely to be well monitored, but private sector abstractions for industry or agriculture are often less well monitored. It isn't clear how the groundwater abstraction statistics in AQUASTAT (called 'fresh groundwater withdrawal) are estimated. It is very likely that the methods of estimating groundwater abstraction are different in different countries. In some countries, estimates of the widespread dispersed groundwater abstraction may be included in national scale statistics, but perhaps not in others. Some countries have better monitoring systems for large scale groundwater abstractions than others. Altogether, this means that it is not possible to be very confident about reliable the groundwater abstraction statistics are, and it may not be possible to confidently compare data between countries.

Explanations of AQUASTAT variables

Explanations of some AQUASTAT variables, including all those quoted in the Atlas, are given in the tables below. These are based on the FAO AQUASTAT glossary.

Note that the units quoted in the Atlas and in the table below may be different from those quoted in AQUASTAT.

Key groundwater resource statistics

AQUASTAT Variable	Explanation
Groundwater produced internally (million cubic metres/year)	This is AQUASTAT's statistic for long term annual average **groundwater recharge** which comes from precipitation (rainfall) inside the country boundary. It is estimated by calculating an annual infiltration rate (in arid countries) or a river base flow (in humid countries).
Estimated total renewable groundwater (million cubic metres/year)	AQUASTAT calculates this as the sum of internal renewable groundwater resources (i.e. groundwater recharge - called by AQUASTAT 'groundwater produced internally') and external renewable groundwater resources (i.e. groundwater entering/flowing into the country). I.e., this is **all recharge inside the country plus all groundwater flowing into the country from outside.** Note that where there is no data on groundwater flows into the country, this value will be identical to the 'groundwater produced internally' (recharge) value.
Exploitable: Regular renewable groundwater resources (million cubic metres/year)	This is defined as the groundwater resources available for development, taking into account environmental, economic and engineering factors. It is specifically defined as the **average groundwater flow available 90% of the time and economically/environmentally viable to extract**. AQUASTAT states that estimation methods for this vary from country to country, so it may be difficult to use this to compare between countries.

Fresh groundwater withdrawal (primary and secondary) (Million cubic metres/year)	This is AQUASTAT's statistic for **groundwater abstraction**. It includes primary and secondary groundwater withdrawals (abstractions). Primary groundwater withdrawal is groundwater that has not been abstracted before. Secondary withdrawal is groundwater that was previously abstracted and returned to an aquifer (e.g., including irrigation returns or recharge of waste water). In practise, distinguishing between primary and secondary withdrawals is rarely possible. Additionally, estimating groundwater abstractions in most African countries is very difficult, because they are widely distributed and often unrecorded. The estimates of groundwater withdrawal (abstraction) are likely to be calculated differently in different countries. They may not include any estimate of distributed groundwater abstraction from the boreholes, wells and springs used by most people in Africa for water supplies.
Groundwater: entering the country (million cubic metres/year)	Defined as the long term average annual quantity of groundwater naturally flowing into (entering) the country that is not submitted to treaties or secured through treaties. Another similar AQUASTAT variable, (Groundwater: accounted inflow), has not been included in the Atlas: this is defined as the long term average annual quantity of groundwater annually entering the country, taking into consideration eventual treaties. There are no countries in Africa with agreed treaties on the quantity of groundwater entering the country, and so there is no practical difference between these two variables. Additionally, very few countries in Africa hold any data on any groundwater inflows from outside the country.
Groundwater: leaving the country to other countries (Million cubic metres/year)	Defined as the average annual quantity of groundwater naturally flowing out of (leaving) the country, without treaties. It refers to groundwater flowing to other countries, NOT any groundwater that flows to the sea for countries located next to the sea. Another similar AQUASTAT variable, (Groundwater: accounted outflow to other countries), has not been included in the Atlas. This is defined as the long term average annual quantity of groundwater leaving the country that is not submitted to treaties or secured through treaties. There are no countries in Africa with agreed treaties on the quantity of groundwater leaving the country, and so there is no practical difference between these two variables. Additionally, very few countries in Africa hold any data on any groundwater outflows to other countries, or to the sea.

Key general water resource statistics

AQUASTAT Variable	Explanation
Total renewable water resources (million cubic metres/year)	This is defined as the sum of internal renewable water resources and external renewable water resources. It corresponds to the maximum theoretical yearly amount of water available for a country at a given moment. It is estimated as: [Total renewable surface water] + [Total renewable groundwater] - [Overlap between surface water and groundwater]
Total exploitable water resources (million cubic metres/year)	Estimated as the sum of [Exploitable: total renewable surface water] + [Exploitable: regular renewable groundwater]. Note that methods of estimating exploitable water resources vary from country to country.

Total internal renewable water resources (cubic metres/inhabitant/year)	Estimated by: [Long term average river flow] + [Long term average recharge (groundwater produced internally)] - [Overlap from the sum of surface water and groundwater resources] / [Population].
Freshwater withdrawal as % of total renewable water resources (%)	This is defined as total freshwater withdrawn (abstracted) in a given year, expressed as a percentage of the total renewable water resources. It is estimated as: [Total freshwater withdrawal (primary and secondary)] / [Total renewable water resources] * 100

Key general water supply and use statistics, including for agriculture

AQUASTAT Variable	Explanation
Total/Rural/Urban population with access to safe drinking water (%)	This is the percentage of the total, rural or urban (respectively) population that uses improved water sources. An improved source is defined as one that is likely to provide "safe" water, such as a household connection, a borehole, etc. Note that the lack of current information does not yet allow a relationship to be established between access to safe water and access to improved sources, but WHO and UNICEF are examining this relationship.
Population affected by water related disease (per 1000 inhabitants)	AQUASTAT defines three types of water-related diseases on which to base this statistic: (i) water-borne diseases, which arise from infected water and are transmitted when the water is used for drinking or cooking (for example cholera, typhoid); (ii) water-based diseases, in which water provides the habitant for host organisms of parasites ingested (for example shistomasomiasis or bilharzia); and (iii) water-related insect vector diseases, in which insect vectors rely on water as habitat but transmission is not through direct contact with water (for example malaria, onchocerciasis or river blindness, elephantiasis).
Industrial water withdrawal (all water sources) (million cubic metres/year)	This is the annual quantity of self-supplied water withdrawn (abstracted) for industrial uses. It can include water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal from fossil groundwater, direct use of agricultural drainage water, direct use of (treated) wastewater, and desalinated water. This sector refers to self-supplied industries not connected to the public distribution network. It includes water for the cooling of thermoelectric and nuclear power plants, but it does not include hydropower. Water withdrawn by industries that are connected to the public supply network is generally included in municipal water withdrawal.

Municipal water withdrawal (all water sources) (million cubic metres/year)	This is the annual quantity of water withdrawn (abstracted) primarily for the direct use by the population. It can include water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal from fossil groundwater, direct use of agricultural drainage water, direct use of (treated) wastewater, and desalinated water. It is usually calculated as the total water withdrawn by the public distribution network, and therefore in some countries it includes that part of industrial and (urban) agricultural withdrawal which is connected to, and derived from, the municipal network.
Agricultural water withdrawal (all water sources) (million cubic metres/year)	This is the annual quantity of self-supplied water withdrawn (abstracted) for irrigation, livestock and aquaculture purposes. It can include water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal from fossil groundwater, direct use of agricultural drainage water, direct use of (treated) wastewater, and desalinated water. Water for the dairy and meat industries and industrial processing of harvested agricultural products is included under industrial water withdrawal.
Irrigation water withdrawal (all water sources) (million cubic metres/year)	This is the annual quantity of water withdrawn (abstracted) for irrigation purposes. In the AQUASTAT database water withdrawal for irrigation is a sub-set of agricultural water withdrawal. The amount of water withdrawn for irrigation by far exceeds the consumptive use of irrigation because of water lost in its distribution from its source to the crops. The term "water requirement ratio" (sometimes also called "irrigation efficiency") is used to indicate the ratio between the net irrigation water requirements or crop water requirements, which is the volume of water needed to compensate for the deficit between potential evapotranspiration and effective precipitation over the growing period of the crop, and the amount of water withdrawn for irrigation including the losses.
Irrigation water requirement (all water sources) (million cubic metres/year)	This is the quantity of irrigation water (not including precipitation (rainfall) or soil moisture) that is needed for normal crop production. It is the amount of water to ensure that crops receive their full crop water requirement (i.e. the irrigation consumptive water use, as well as, where relevant, extra water for flooding of paddy fields to facilitate land preparation and protect the plant and for leaching salt when necessary to allow for plant growth). It is usually expressed in water depth (millimetres) or water volume (m^3) and may be stated in monthly, seasonal or annual terms, or for a crop period. It corresponds to net irrigation water requirement.
Total area of country cultivated (%)	This is calculated as: [Cultivated area (arable land + permanent crops)] / [Total area of the country] * 100
Area of permanent crops (ha)	Permanent crops are sown or planted once, and then occupy the land for some years and need not be replanted after each annual harvest, such as cocoa, coffee and rubber. This category includes flowering shrubs, fruit trees, nut trees and vines, but excludes trees grown for wood or timber, and permanent meadows and pastures.
Cultivated land (arable and permanent crops) (ha)	This is the sum of the arable land area and the area under permanent crops, calculated by: [Arable land area] + [Permanent crops area]

Area equipped for irrigation by groundwater (ha)	This is the part of the total area equipped for irrigation that is irrigated from wells (shallow wells and deep tube wells) or springs.
Area equipped for irrigation by mixed surface water and groundwater (ha)	This is the part of the area equipped for irrigation that is irrigated from mixed surface water and groundwater.

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