Last updated: 11 July 2017  
  
  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity  
  
Indicator 6.4.2: Level of water stress: freshwater withdrawal as a proportion of available freshwater resources  
  
  
  
Institutional information  
  
  
  
Organization(s):  
  
  
  
Food and Agriculture Organization of the United Nations (FAO)  
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
  
  
The level of water stress: freshwater withdrawal as a proportion of available freshwater resources is the ratio between total freshwater withdrawn by all major sectors and total renewable freshwater resources, after taking into account environmental water requirements. Main sectors, as defined by ISIC standards, include agriculture; forestry and fishing; manufacturing; electricity industry; and services. This indicator is also known as water withdrawal intensity.  
  
  
  
Rationale:  
  
  
  
The purpose of this indicator is to show the degree to which water resources are being exploited to meet the country's water demand. It measures a country's pressure on its water resources and therefore the challenge on the sustainability of its water use. It tracks progress in regard to “withdrawals and supply of freshwater to address water scarcity”, i.e. the environmental component of target 6.4.  
  
  
  
The indicator shows to what extent water resources are already used, and signals the importance of effective supply and demand management policies. It indicates the likelihood of increasing competition and conflict between different water uses and users in a situation of increasing water scarcity. Increased water stress, shown by an increase in the value of the indicator, has potentially negative effects on the sustainability of the natural resources and on economic development. On the other hand, low values of the indicator indicate that water does not represent a particular challenge for economic development and sustainability.  
  
  
  
Concepts:  
  
  
  
This indicator provides an estimate of pressure by all sectors on the country’s renewable freshwater resources. A low level of water stress indicates a situation where the combined withdrawal by all sectors is marginal in relation to the resources, and has therefore little potential impact on the sustainability of the resources or on the potential competition between users. A high level of water stress indicates a situation where the combined withdrawal by all sectors represents a substantial share of the total renewable freshwater resources, with potentially larger impacts on the sustainability of the resources and potential situations of conflicts and competition between users.   
  
  
  
Total renewable freshwater resources (TRWR) are expressed as the sum of internal and external renewable water resources. The terms “water resources” and “water withdrawal” are understood here as freshwater resources and freshwater withdrawal.   
  
  
  
Internal renewable water resources are defined as the long-term average annual flow of rivers and recharge of groundwater for a given country generated from endogenous precipitation.   
  
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External renewable water resources refer to the flows of water entering the country, taking into consideration the quantity of flows reserved to upstream and downstream countries through agreements or treaties.   
  
  
  
Total freshwater withdrawal (TWW) is the volume of freshwater extracted from its source (rivers, lakes, aquifers) for agriculture, industries and municipalities. It is estimated at the country level for the following three main sectors: agriculture, municipalities (including domestic water withdrawal) and industries. Freshwater withdrawal includes primary freshwater (not withdrawn before), secondary freshwater (previously withdrawn and returned to rivers and groundwater, such as discharged wastewater and agricultural drainage water) and fossil groundwater. It does not include non-conventional water, i.e. direct use of treated wastewater, direct use of agricultural drainage water and desalinated water. TWW is in general calculated as being the sum of total water withdrawal by sector minus direct use of wastewater, direct use of agricultural drainage water and use of desalinated water.   
  
  
  
Environmental water requirements (Env.) are the quantities of water required to sustain freshwater and estuarine ecosystems. Water quality and also the resulting ecosystem services are excluded from this formulation which is confined to water volumes. This does not imply that quality and the support to societies which are dependent on environmental flows are not important and should not be taken care of. Methods of computation of Env. are extremely variable and range from global estimates to comprehensive assessments for river reaches. For the purpose of the SDG indicator, water volumes can be expressed in the same units as the TWW, and then as percentages of the available water resources.  
  
  
  
Comments and limitations:  
  
  
  
Water withdrawal as a percentage of water resources is a good indicator of pressure on limited water resources, one of the most important natural resources. However, it only partially addresses the issues related to sustainable water management.   
  
  
  
Supplementary indicators that capture the multiple dimensions of water management would combine data on water demand management, behavioural changes with regard to water use and the availability of appropriate infrastructure, and measure progress in increasing the efficiency and sustainability of water use, in particular in relation to population and economic growth. They would also recognize the different climatic environments that affect water use in countries, in particular in agriculture, which is the main user of water. Sustainability assessment is also linked to the critical thresholds fixed for this indicator and there is no universal consensus on such threshold.   
  
  
  
Trends in water withdrawal show relatively slow patterns of change. Usually, three-five years are a minimum frequency to be able to detect significant changes, as it is unlikely that the indicator would show meaningful variations from one year to the other.   
  
  
  
Estimation of water withdrawal by sector is the main limitation to the computation of the indicator. Few countries actually publish water use data on a regular basis by sector.   
  
  
  
Renewable water resources include all surface water and groundwater resources that are available on a yearly basis without consideration of the capacity to harvest and use this resource. Exploitable water resources, which refer to the volume of surface water or groundwater that is available with an occurrence of 90% of the time, are considerably less than renewable water resources, but no universal method exists to assess such exploitable water resources.  
  
  
  
There is no universally agreed method for the computation of incoming freshwater flows originating outside of a country's borders. Nor is there any standard method to account for return flows, the part of the water withdrawn from its source and which flows back to the river system after use. In countries where return flow represents a substantial part of water withdrawal, the indicator tends to underestimate available water and therefore overestimate the level of water stress.   
  
  
  
Other limitations that affect the interpretation of the water stress indicator include:   
  
• difficulty to obtain accurate, complete and up-to-date data;   
  
• potentially large variation of sub-national data;   
  
• lack of account of seasonal variations in water resources;  
  
• lack of consideration to the distribution among water uses;   
  
• lack of consideration of water quality and its suitability for use; and  
  
• the indicator can be higher than 100 per cent when water withdrawal includes secondary freshwater (water withdrawn previously and returned to the system), non-renewable water (fossil groundwater), when annual groundwater withdrawal is higher than annual replenishment (over-abstraction) or when water withdrawal includes part or all of the water set aside for environmental water requirements.   
  
Some of these issues can be solved through disaggregation of the index at the level of hydrological units and by distinguishing between different use sectors. However, due to the complexity of water flows, both within a country and between countries, care should be taken not to double-count.  
  
  
  
Methodology  
  
  
  
Computation Method:  
  
  
  
Method of computation: The indicator is computed as the total freshwater withdrawn (TWW) divided by the difference between the total renewable freshwater resources (TRWR) and the environmental water requirements (Env.), multiplied by 100. All variables are expressed in km3/year (109 m3/year).  
  
  
  
Stress (%) = TWW / (TRWR - Env.) \* 100  
  
  
  
It is proposed to classify the level of water stress in three main categories (levels): low, high and very high. The thresholds for the indicator could be country specific, to reflect differences in climate and national water management objectives. Alternatively, uniform thresholds could be proposed using existing literature and taking into account environmental water requirements.  
  
  
  
Disaggregation:  
  
  
  
To compute this indicator sectoral data are needed. The indicator can be disaggregated to show the respective contribution of different sectors to the country’s water stress, and therefore the relative importance of actions needed to contain water demand in the different sectors (agriculture, municipalities and industry).   
  
  
  
At national level, water resources and withdrawal are estimated or measured at the level of appropriate hydrological units (river basins, aquifers). It is therefore possible to obtain a geographical distribution of water stress by hydrological unit, thus allowing for more targeted response in terms of water demand management.  
  
  
  
Treatment of missing values:  
  
  
  
At country level  
  
  
  
If scattered data are available, a methodology will be developed with regards to inter- and extrapolation  
  
  
  
At regional and global levels  
  
  
  
For the MDGs, latest values were used to obtain regional or global aggregates, even if not available for the same year. It is expected that through the baseline that will be produced for the SDG monitoring, data for more or less the same range of years become available.  
  
  
  
Regional aggregates:  
  
  
  
Regional and global estimates will be done by summing up the national figures on renewable freshwater resources and total freshwater withdrawal, considering only the internal renewable water resources of each country in order to avoid double counting.  
  
  
  
Sources of discrepancies:  
  
  
  
Differences might occur due to the following, amongst others: For national estimates incoming water is counted as being part of the country’s available water resources, while global estimates can only be done by adding up the internal renewable water resources (water generated within the country) of all countries in order to avoid double counting.  
  
  
  
Methods and guidance available to countries for the compilation of the data at the national level:  
  
  
  
This indicator provides an estimate of pressure by all sectors on the country’s renewable freshwater resources. A low level of water stress indicates a situation where the combined withdrawal by all sectors is marginal in relation to the resources, and has therefore little potential impact on the sustainability of the resources or on the potential competition between users. A high level of water stress indicates a situation where the combined withdrawal by all sectors represents a substantial share of the total renewable freshwater resources, with potentially larger impacts on the sustainability of the resources and potential situations of conflicts and competition between users.  
  
The indicator is computed based on three components:  
  
  
  
Total renewable freshwater resources (TRWR)  
  
Total freshwater withdrawal (TWW)  
  
Environmental flow requirements (EFR)  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
Several documents exist that can be used to support countries in the computation of this indicator. Among them:  
  
  
  
Understanding AQUASTAT - FAO's global water information system  
This information note covers a twenty year history of the collection and analysis of water-related data and its dissemination as an international public good, freely available to all. The process of collecting and checking the data has resulted in the establishment of a unique network of collaborators who provide data, use data from other countries for comparative purposes, and exchange views and experiences on how best to measure and account for water-related use. Users range from international private companies to non-governmental organizations, and virtually all significant reports related to water depend on the data provided by AQUASTAT.  
http://www.fao.org/3/a-bc817e.pdf  
  
  
  
Renewable Water Resources Assessment - 2015 AQUASTAT methodology review  
http://www.fao.org/3/a-bc818e.pdf  
  
  
  
Global database on municipal wastewater production, collection, treatment, discharge and direct use in agriculture   
This paper describes the rationale and method to setup and feed the AQUASTAT database on municipal wastewater production, collection, treatment, discharge or direct use in agriculture. The best available sources of information have been reviewed, including peer-reviewed papers, proceedings of workshops, conferences and expert meetings, global or regional databases, as well as country briefs, national reports and direct communications by country government officials and experts  
http://www.fao.org/3/a-bc823e.pdf  
  
  
  
Cooling water for energy generation and its impact on national-level water statistics   
This technical note, describing the issue of cooling water for energy generation and its impact on national-level water statistics, has two purposes: 1) to act as a general informational resource and 2) to encourage governmental agencies responsible for water usage to gather and report information disaggregated by sub-sector (keeping thermoelectric withdrawals separate from industrial and hydroelectric withdrawals), and to determine the point at which lower water withdrawal designs are more favourable, even if the required capital cost is higher.  
http://www.fao.org/3/a-bc822e.pdf  
  
  
  
Municipal and industrial water withdrawal modelling for the years 2000 and 2005 using statistical methods   
This document describes the efforts to generate models that estimate the municipal and industrial water withdrawals for the years 2000 and 2005.   
http://www.fao.org/3/a-bc821e.pdf  
  
  
  
Disambiguation of water statistics   
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, usage, withdrawal, consumption, abstraction, extraction, utilization, supply and demand are often used without clearly stating what is meant.   
http://www.fao.org/3/a-bc816e.pdf  
  
  
  
Country survey on water use for agriculture and rural development  
Questionnaire for water survey  
These Guidelines and Questionnaire have been prepared for the updating of the data and country profiles in AQUASTAT.  
http://www.fao.org/nr/water/aquastat/sets/aq-5yr-quest\_eng.xls  
http://www.fao.org/nr/water/aquastat/sets/aq-5yr-guide\_eng.pdf  
  
  
  
International Recommendations for Water Statistics  
The International Recommendations for Water Statistics (IRWS) were developed to help strengthen national information systems for water in support of design and evaluation of Integrated Water Resources Management (IWRM) policies.  
https://unstats.un.org/UNSD/envaccounting/irws/  
  
  
  
UNSD/UNEP Questionnaire on Environment Statistics – Water Section  
http://unstats.un.org/unsd/environment/questionnaire.htm  
http://unstats.un.org/unsd/environment/qindicators.htm  
  
  
  
UNSD ‘National Accounts Main Aggregates Database’  
http://unstats.un.org/unsd/snaama/selbasicFast.asp  
  
  
  
Quality assurance:  
  
  
  
Every data in AQUASTAT goes through a thorough validation process:  
  
Before uploading, data is compared to other variables to ensure it is logically correct (in other words: 1+2=3) and whether the reference used is not leading back to AQUASTAT itself. In other words, AQUASTAT frequently finds data for 2014, which is really AQUASTAT data for 2000 with the year changed (most probably when the data was harvested).  
  
  
  
During uploading into the Main Database, another validation process takes place, using a set of about 300 validation rules. Of these, about 100 rules are obligatory rules, which means that if the data-point doesn't obey this rule, the validation process cannot go on. For example, the cultivated area of a country cannot be larger than the total area of the country. The other set of about 200 validation rules are warning signs for the person doing the validation. For example, in general the area equipped for irrigation using surface irrigation technology is at least half of the total area equipped for irrigation. However, in some countries the localized irrigation area or the sprinkler irrigation area might be larger than the surface irrigation area. If this is the case, then a warning pops up during validation for the analyst to check whether for this country it is possible. Also during the validation process each new data-point is compared to other data already available for this variable in other years or in the same year. If it is impossible to harmonize or reconcile the different data, then one or the other data-point has to be deleted from the database.   
  
http://www.fao.org/nr/water/aquastat/sets/WhyDBisEmpty\_eng.pdf  
http://www.fao.org/nr/water/aquastat/About\_us/index3.stm  
  
  
  
Beyond the usual AQUASTAT validation described above, in the compilation of the indicator countries will be encouraged and supported in setting up their own quality control system, ensuring that all data used in the computation are checked, and that consistency is kept over the years to ensure comparability and robust identification of trends.  
  
  
  
The indicator requires data from different sectors of expertise. Internationally, they are available of different datasets from various institutions, such as FAO, UNSD and IWMI. Each of these institutions has its own established mechanism to consult and validate the data with the countries.  
  
For the data deriving from FAOSTAT and AQUASTAT, data are collected in countries through surveys consisting of data collection and country description by means of a detailed questionnaires were the source reference and comments are associated with each value, through national resource persons. Critical analysis of information and data processing is done by FAO staff. Data are then organized in standard data tables, and feedback and approval is sought from national institutions before publication and dissemination.  
  
  
  
However, for the SDG process a specific mechanism will be put in place, consisting in the identification in each country, by the national government, of a national focal point and a technical team, in charge of the collection and computation of the indicator, in close consultation with FAO. This system has been successfully tested during the initial phase of the GEMI project, carried out by FAO and other seven UN agencies, coordinated by UN-Water.  
  
  
  
For those countries that could initially have difficulties in compiling and computing the indicator, FAO will provide support and ultimately will be able to produce the indicator starting from internationally available data. However, no data will be made public without the prior approval by the relevant national authorities.  
  
  
  
Data Sources  
  
  
  
Description:  
  
  
  
Data for this indicator are usually collected by national ministries and institutions having water-related issues in their mandate, such as ministries of water resources, agriculture, or environment. Data are mainly published within national water resources and irrigation master plans, national statistical yearbooks and other reports (such as those from projects, international surveys or results and publications from national and international research centres).  
  
  
  
The data for the indicator are collected through questionnaires to be answered by the relevant institutions in each country. Examples of the questionnaires that can be used can be found at:  
  
  
  
AQUASTAT  
  
www.fao.org/nr/water/aquastat/sets/aq-5yr-quest\_eng.xls  
  
  
  
UNSD/UNEP  
  
http://unstats.un.org/unsd/environment/Questionnaires/q2013Water\_English.xls  
  
  
  
OECD/Eurostat  
  
http://ec.europa.eu/eurostat/ramon/coded\_files/OECD\_ESTAT\_JQ\_Manual\_version\_2\_21.pdf  
  
  
  
Collection process:  
  
  
  
Official counterparts at country level are the line ministry for water resources and the national statistics office  
  
Countries are expected to put in place a process of Quality Control (QC), Quality Assurance (QA) and data verification. The process should be carried out internally for the QC part, ensuring that all the planned steps are properly carried out at each round of data collection. The QA should be carried out by independent experts, either national or international, to assess the consistence and robustness of the data produced. Finally, where possible the resulting data should be verified by comparison with similar data from other sources.  
  
As the data will be collected through different questionnaires, harmonization will be needed among the eventual differences in definitions and aggregations.  
  
  
  
Data Availability  
  
  
  
Description:  
  
  
  
Countries (2010 to present):  
  
Asia and Pacific 2  
  
Africa 6  
  
Latin America and the Caribbean 16  
  
Europe, North America, Australia, New Zealand and Japan 24  
  
  
  
Countries (2000-2009):  
  
Asia and Pacific 42  
  
Africa 49  
  
Latin America and the Caribbean 27  
  
Europe, North America, Australia, New Zealand and Japan 47  
  
  
  
Time series:  
  
  
  
1961-2015 (Discontinuous, depending on country)   
  
  
  
Calendar  
  
  
  
Data collection:  
  
  
  
2016-2018  
  
  
  
Data release:  
  
  
  
New data for the indicator are planned to be produced for most countries between 2017 and 2018.  
  
  
  
Data providers  
  
  
  
Description:  
  
  
  
National Statistical Offices Line ministry National consultants The institutions responsible for data collection at national level vary according to countries. However, in general data for this indicator are provided by the Ministry of Agriculture, Ministry of Water and Ministry of Environment, and sometimes channelled through the National statistical Office.  
  
  
  
Data compilers  
  
  
  
Food and Agriculture Organization of the United Nations (FAO) through AQUASTAT, its global water information system (http://www.fao.org/nr/aquastat).  
  
  
  
References  
  
  
  
URL:  
  
  
  
www.fao.org/nr/aquastat  
  
  
  
References:  
  
  
  
Food and Agricultural Organization of the United Nations (FAO). AQUASTAT, FAO's Global Water Information System. Rome. Website http://www.fao.org/nr/aquastat.   
  
  
  
The following resources of specific interest to this indicator are available on this site:   
  
AQUASTAT glossary (http://www.fao.org/nr/water/aquastat/data/glossary/search.html).   
  
AQUASTAT Main country database (http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en)   
  
AQUASTAT Water use (http://www.fao.org/nr/water/aquastat/water\_use/index.stm).   
  
AQUASTAT Water resources (http://www.fao.org/nr/water/aquastat/water\_res/index.stm).   
  
AQUASTAT publications dealing with concepts, methodologies, definitions, terminologies, metadata, etc. (http://www.fao.org/nr/water/aquastat/catalogues/index.stm)  
  
For surface water, environmental water requirement databases include:  
  
 http://waterdata.iwmi.org/apps/flow\_management\_classes/  
  
 http://www.iwmi.cgiar.org/resources/models-and-software/environmental-flow-calculators/  
  
 http://waterdata.iwmi.org/Applications/Global\_Assessment\_Environmental\_Water\_Requirements\_Scarcity/  
  
UNSD/UNEP Questionnaire on Environment Statistics – Water Sectionhttp://unstats.un.org/unsd/environment/qindicators.htm   
  
Framework for the Development of Environment Statistics (FDES 2013) (Chapter 3) http://unstats.un.org/unsd/environment/FDES/FDES-2015-supporting-tools/FDES.pdf  
  
OECD/Eurostat Questionnaire on Environment Statistics – Water Section  
  
International Recommendations for Water Statistics (IRWS) (2012) http://unstats.un.org/unsd/envaccounting/irws/  
  
  
  
Related indicators as of February 2020  
  
  
  
6.4.1:  
  
Change in water-use efficiency over time  
  
  
  
6.1.1:  
  
Proportion of population using safely managed drinking water services  
  
  
  
6.3.1:  
  
Proportion of wastewater safely treated  
  
  
  
6.6.1:  
  
Change in the extent of water-related ecosystems over time  
  
  
  
6.5.1:  
  
Degree of integrated water resources management implementation (0-100)  
  
  
  
2.4.1:  
  
Proportion of agricultural area under productive and sustainable agriculture  
  
  
  
15.3.1:  
  
Proportion of land that is degraded over total land area  
  
  
  
1.5.1:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
  
  
11.5.1:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]

Last updated: 29 September 2017  
  
  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.2: By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations  
  
Indicator 6.2.1: Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water  
  
  
  
Institutional information  
  
  
  
Organization(s):  
  
  
  
World Health Organization (WHO)  
  
  
  
United Nations Children's Fund (UNICEF)  
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
  
  
The Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water is currently being measured by the proportion of the population using a basic sanitation facility which is not shared with other households and where excreta is safely disposed in situ or treated off-site. ‘Improved’ sanitation facilities include: flush or pour flush toilets to sewer systems, septic tanks or pit latrines, ventilated improved pit latrines, pit latrines with a slab, and composting toilets.   
  
  
  
Population with a basic handwashing facility: a device to contain, transport or regulate the flow of water to facilitate handwashing with soap and water in the household.  
  
  
  
Rationale:  
  
  
  
MDG target 7C called for ‘sustainable access’ to ‘basic sanitation’. The JMP developed the metric of use of ‘improved’ sanitation facilities, which are likely to hygienically separate human excreta from human contact, and has used this indicator to track progress towards the MDG target since 2000. International consultations since 2011 have established consensus on the need to build on and address the shortcomings of this indicator; specifically, to address normative criteria of the human right to water including accessibility, acceptability, and safety. Furthermore, the safe management of faecal wastes should be considered, as discharges of untreated wastewater into the environment create public health hazards.  
  
  
  
The above consultation concluded that post-2015 targets, which apply to all countries, should go beyond the basic level of access and address indicators of safe management of sanitation services, including dimensions of accessibility, acceptability and safety. The Expert Working Group called for analysis of faecal waste management along the sanitation chain, including containment, emptying of latrines and septic tanks, and safe on-site disposal or the transport and treatment of wastes at a designated treatment site. Classification of treatment will be based on categories defined by SEEA and the International Recommendations for Water Statistics and following a laddered approach (primary, secondary and tertiary treatment).  
  
  
  
Handwashing with soap is widely agreed to be the top hygiene priority for improving health outcomes. In 2008 and 2009, the JMP supported a review of indicators of handwashing practice, and determined that the most practical approach leading to reliable measurement of handwashing in national household surveys was observation of the place where household members wash their hands and noting the presence of water and soap (or local alternative) at that location. This provides a measure of whether households have the necessary tools for handwashing and is a proxy for their behaviour. Observation by survey enumerators represents a more reliable, valid and efficient indicator for measuring handwashing behaviour than asking individuals to report their own behaviour.  
  
  
  
Concepts:  
  
  
  
Improved sanitation facilities include the following: flush or pour flush toilets to sewer systems, septic tanks or pit latrines, ventilated improved pit latrines, pit latrines with a slab, and composting toilets.  
  
  
  
Safely disposed in situ; when pit latrines and septic tanks are not emptied, the excreta may still remain isolated from human contact and can be considered safely managed. For example, with the new SDG indicator, households that use twin pit latrines or safely abandon full pit latrines and dig new facilities, a common practice in rural areas, would be counted as using safely managed sanitation services.  
  
  
  
Treated offsite; not all excreta from toilet facilities conveyed in sewers (as wastewater) or emptied from pit latrines and septic tanks (as faecal sludge) reaches a treatment site. For instance, a portion may leak from the sewer itself or, due to broken pumping installations, be discharged directly to the environment. Similarly, a portion of the faecal sludge emptied from containers may be discharged into open drains, to open ground or water bodies, rather than being transported to a treatment plant. And finally, even once the excreta reaches a treatment plant a portion may remain untreated, due to dysfunctional treatment equipment or inadequate treatment capacity, and be discharged to the environment. For the purposes of SDG monitoring, adequacy of treatment will initially be assessed based on the reported level of treatment.  
  
  
  
A handwashing facility with soap and water: a handwashing facility is a device to contain, transport or regulate the flow of water to facilitate handwashing. This indicator is a proxy of actual handwashing practice, which has been found to be more accurate than other proxies such as self-reports of handwashing practices.  
  
  
  
Comments and limitations:  
  
  
  
A framework for measuring faecal waste flows and safety factors has been developed and piloted in 12 countries (World Bank Water and Sanitation Program, 2014), and is being adopted and scaled up within the sanitation sector. This framework has served as the basis for indicators 6.2.1 and 6.3.1. Data on safe disposal and treatment are not available for all countries. However, sufficient data were available to make global and regional estimates of safely managed sanitation services in 2017.  
  
  
  
Presence of a handwashing station with soap and water does not guarantee that household members consistently wash hands at key times, but has been accepted as the most suitable proxy. Data were available for 70 countries in 2017.  
  
  
  
Methodology  
  
  
  
Computation Method:  
  
  
  
Method of computation: Household surveys and censuses provide data on use of types of basic sanitation facilities listed above, as well as the presence of handwashing materials in the home.   
  
  
  
The percentage of the population using safely managed sanitation services is calculated by combining data on the proportion of the population using different types of basic sanitation facilities with estimates of the proportion of faecal waste which is safely disposed in situ or treated off-site.   
  
  
  
The JMP estimates use of basic sanitation facilities for each country, separately in urban and rural areas, by fitting a regression model to a series of data points from household surveys and censuses. This approach was used to report on use of ‘improved sanitation’ facilities for MDG monitoring. The JMP is evaluating the use of alternative statistical estimation methods as more data become available.  
  
  
  
The JMP 2017 update and SDG baselines report describes in more detail how estimates of the proportion of household wastewater that is safely disposed of in situ or treated off-site have been combined with data on use of different types of sanitation facilities, as recorded in the JMP global database.   
  
  
  
Disaggregation:  
  
  
  
Disaggregation by place of residence (urban/rural) and socioeconomic status (wealth, affordability) is possible for all countries. Disaggregation by other stratifies of inequality (subnational, gender, disadvantaged groups, etc.) will be made where data permit. Sanitation services will be disaggregated by service level (including no services, basic, and safely managed services) following the JMP sanitation ladder.  
  
  
  
Treatment of missing values:  
  
  
  
At country level  
  
The JMP method uses a simple regression model to generate time series estimates for all years including for years without data points. The JMP then shares all its estimates using its country consultation mechanism to get consensus from countries before publishing its estimates.  
  
  
  
At regional and global levels  
  
The JMP does not publish estimates for countries for which national data are not available. Regional and global estimates are made for basic services as long as data are available for 50% of the population with the region, weighting by the latest UNPD population estimates. Regional and global estimates for safely managed services used a lower threshold of 30% for the JMP 2017 update and SDG baselines report.  
  
  
  
Regional aggregates:  
  
  
  
For more details on JMP rules and methods, please consult the website: www.washdata.org.  
  
  
  
Sources of discrepancies:  
  
  
  
JMP estimates are based on national sources of data approved as official statistics. Differences between global and national figures arise due to differences in indicator definitions and methods used in calculating national coverage estimates. In some cases national estimates are based on the most recent data point rather than from regression on all data points as done by the JMP. In some cases national estimates draw on administrative sector data rather than the nationally representative surveys and censuses used by the JMP.  
  
  
  
Data Sources  
  
  
  
Description:  
  
  
  
Access to water and sanitation are considered core socio-economic and health indicators, and key determinants of child survival, maternal, and children’s health, family wellbeing, and economic productivity. Drinking water and sanitation facilities are also used in constructing wealth quintiles used by many integrated household surveys to analyse inequalities between rich and poor. Access to sanitation is therefore a core indicator for most household surveys. Currently the JMP database holds over 1,700 surveys and censuses. In high-income countries where household surveys or censuses do not always collect information on basic access, data are drawn from administrative records.  
  
  
  
Estimates of excreta management will be collected from countries and used to adjust the data on use of basic sanitation facilities as needed. Administrative, population and environmental data can also be combined to estimate safe disposal or transport of excreta, when no country data are available. Data on disposal or treatment of excreta are limited but estimates for safe management of faecal wastes can be calculated based on faecal waste flows associated with the use of different types of basic sanitation facility.  
  
  
  
Since the handwashing with soap survey questions were standardized in 2009, over 70 DHS and MICS surveys have included the module. JMP published handwashing estimates for 12 countries in its 2014 update, for 54 countries in its 2015 update, and for 70 countries in its 2017 update.  
  
  
  
The population data used by JMP, including the proportion of the population living in urban and rural areas, are those established by the UN Population Division.  
  
  
  
Collection process:  
  
  
  
WHO is required by World Health Assembly resolution to consult on all WHO statistics, and seek feedback from countries on data about countries and territories. Before publishing, all JMP estimates undergo rigorous country consultations facilitated by WHO and UNICEF country offices. Often these consultations give rise to in-country visits, and meetings about data on drinking water, sanitation and hygiene services and the monitoring systems that collect these data. The JMP has been engaged with more than fifty countries over the last 10 years in explaining JMP estimates, and reasons for discrepancies if any.   
  
  
  
Data Availability  
  
  
  
Description:  
  
  
  
In the JMP 2017 report estimates for basic sanitation services were available for nearly all countries and estimates for safely managed sanitation services were made for 96 countries at national level. Sufficient data were available to estimate safely managed drinking water services at the regional level for the following five SDG regions: Australia and New Zealand, Eastern Asia and South-eastern Asia, Latin America and the Caribbean, Northern America and Europe, Western Asia and Northern Africa  
  
  
  
Data on basic handwashing facilities were available for 70 countries and regional estimates were possible for Sub-Saharan Africa and Western Asia and Northern Africa.   
  
  
  
Time series:  
  
  
  
Time series data are available for the basic sanitation level of service over the period 2000-2015. These serve as the foundation for the safely managed sanitation service indicator. Some elements of safe management (e.g. wastewater treatment) were not collected during the MDG period and trend analysis will only be possible several years into the SDGs. (From 2000 to 2015)  
  
  
  
Calendar  
  
  
  
Data collection:  
  
  
  
The current biennial data collection cycle begins in October during an even year and estimates are published during the following year.   
  
  
  
Data release:  
  
  
  
The baseline SDG report was published in July 2017 and feed into the SG’s 2017 SDG Progress Report. . The estimates will be updated in 2019.  
  
  
  
Data providers  
  
  
  
National statistics offices, Ministries of water, sanitation, health, environment. Regulators of water and sanitation services.  
  
  
  
Data compilers  
  
  
  
Name:  
  
  
  
WHO/UNICEF  
  
  
  
Description:  
  
  
  
WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene  
  
  
  
References  
  
  
  
URL:  
  
  
  
www.washdata.org  
  
  
  
References:  
  
  
  
JMP website: www.washdata.org.  
  
  
  
JMP 2017 update and SDG baselines  
  
https://washdata.org/report/jmp-2017-report-final  
  
  
  
Ram, P., Practical Guidance for Measuring Handwashing Behaviour: 2013 update, World Bank Water Supply and Sanitation Programme, 2013.   
  
  
  
http://www.wsp.org/sites/wsp.org/files/publications/WSP-Practical-Guidance-Measuring-Handwashing-Behavior-2013-Update.pdf"  
  
  
  
Related indicators as of February 2020  
  
  
  
All targets under Goal 6, as well as targets 1.2, 1.4, 2.2, 3.2, 3.8, 3.9, 4a, 5.4 and 11.1

Last updated: 18 November 2016  
  
  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.5: By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate  
  
Indicator 6.5.2: Proportion of transboundary basin area with an operational arrangement for water cooperation  
  
  
  
Institutional information  
  
Organization(s):  
  
International Hydrological Programme of United Nations Educational, Scientific and Cultural Organization (UNESCO-IHP)  
  
United Nations Economic Commission for Europe (UNECE)  
  
  
  
Concepts and definitions  
  
Definition:  
  
The proportion of transboundary basin area with an operational arrangement for water cooperation is defined as the proportion of transboundary basins area within a country with an operational arrangement for water cooperation. It is derived by adding up the surface area in a country of those transboundary surface water catchments and transboundary aquifers (i.e. ‘transboundary’ basins) that are covered by an operational arrangement and dividing the obtained area by the aggregate total area in a country of all transboundary basins (both catchments and aquifers). The result is multiplied by 100 to obtain it expressed as percentage share.  
  
  
  
Rationale:  
  
Most of the world’s water resources are shared: 592 transboundary aquifers have been identified and transboundary lake and river basins cover nearly one half of the Earth’s land surface and account for an estimated 60% of global freshwater. Approximately 40% of the world’s population lives in river and lake basins shared by two or more countries and over 90% lives in countries that share basins. Development of water resources has impacts across transboundary basins, potentially on co-riparian countries, and use of surface water or groundwater may affect the other resource, these usually being interlinked. Intensive water use, flow regulation or pollution risks going as far as compromising co-riparian countries’ development aspirations and therefore transboundary cooperation is required. However, cooperation is in most cases not advanced.   
  
  
  
Specific agreements or other arrangements concluded between co-riparian countries are a key precondition to ensure long-term, sustainable cooperation. International customary water law (as reflected in the Convention on the Law of the Non-navigational Uses of International Watercourses (New York, 1997), the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992), and the draft Articles on The Law of Transboundary Aquifers (2008; UN General Assembly resolutions 63/124, 66/104, and 68/118)), as well as existing experience and good practices, all point to minimum requirements for operational cooperation. These minimum requirements are captured by the four criteria for operationality.  
  
  
  
This is the basis for the explicit call for transboundary water cooperation in the wording of target 6.5 and the importance of monitoring this indicator to complement indicator 6.5.1 which measures the advancement of Integrated Water Resources Management (IWRM).  
  
  
  
Progress by a particular country towards the cooperation aspect of target 6.5, reflected by the value of indicator 6.5.2, can be achieved either by establishing new operational cooperation arrangements with co-riparian countries, or making existing arrangements operational by developing and regularizing activities, or expanding the coverage of cooperation arrangements with the ultimate objective to cover all surface waters and groundwaters.  
  
  
  
Concepts:  
  
"The proposed monitoring has as basis the spatial coverage of transboundary basins shared by each country, and focuses on monitoring whether these are covered by cooperation arrangements that are operational. The criteria needing to be met for the cooperation on a specific basin being considered “operational” seeks to capture whether the arrangement(s) indeed provide an adequate basis for cooperation in water management.   
  
  
  
Transboundary basins are basins of transboundary waters, that is, of any surface waters (notably rivers, lakes) or groundwaters which mark, cross or are located on boundaries between by two or more states. For the purpose of the calculation of this indicator, for surface waters, the basin is the extent of the catchment area; for groundwater, the area considered is the extent of the aquifer.   
  
  
  
Arrangement for water cooperation: a bilateral or multilateral treaty, convention, agreement or other formal arrangement, such as memorandum of understanding) between riparian countries that provides a framework for cooperation on transboundary water management. Agreements or other kind of formal arrangements may be interstate, intergovernmental, interministerial, interagency or between regional authorities.   
  
  
  
Operational: For an agreement or other kind of formal arrangement (e.g. a memorandum of understanding) for cooperation between the riparian countries to be considered operational, all the following criteria needs to be fulfilled:   
  
  
  
- There is a joint body, joint mechanism or commission (e.g. a river basin organization) for transboundary cooperation   
  
- There are regular formal communications between riparian countries in form of meetings   
  
- There is a joint or coordinated water management plan(s), or joint objectives have been set  
  
- There is a regular exchange of data and information.  
  
  
  
Comments and limitations:  
  
The spatial information on transboundary surface water basins’ boundaries and the extents of the catchment areas are commonly available and essentially static; consequently, once determined, no updating need is expected.  
  
  
  
The information on the areal extent of transboundary aquifers may evolve over time as such information is generally more coarse but likely to improve because of the evolving knowledge on aquifers. Technical studies and exchange of information will improve the delineation and might also lead to the identification of additional transboundary aquifers.  
  
  
  
In situations where more than two riparian countries share a basin, but only some of them have operational cooperation arrangements, the indicator value may mask the gap that a riparian country does not have cooperation arrangements with both its upstream and downstream neighbours. Such complementary information can be obtained by aggregating data at the level of the basins but not from the reporting at the national level.   
  
  
  
The legal basis for cooperation develops slowly: conclusion of new agreements on transboundary waters is commonly a long process that takes many years.   
  
  
  
The operationality of cooperation is more dynamic as it evolves with the expansion of cooperation. The operationality can be expected to evolve over shorter time frames, and in a year or two, progress could potentially be observed.  
  
  
  
Methodology  
  
Computation Method:  
  
Step 1 Identify the transboundary surface waters and aquifers  
  
  
  
While the identification of transboundary surface water is straightforward, the identification of transboundary aquifers requires investigations.  
  
  
  
If there are no transboundary surface waters or groundwaters, reporting is not applicable.  
  
  
  
Step 2 Calculate the surface area of each transboundary basin and the total sum  
  
Commonly at least the basins of the rivers and lakes have been delineated through topographic maps and the basin area is known or easily measurable.   
  
  
  
The total transboundary surface area in the country is the sum of the surface areas in the country of each of the transboundary basins and aquifers (expressed in km2). Transboundary areas for different types of systems (e.g. river basin and aquifer) or multiple aquifers may overlap. The area of transboundary aquifers, even if located within a transboundary river basin, should be added to be able to track progress of cooperation on transboundary aquifers.   
  
  
  
The calculations can most easily be carried with Geographical Information Systems (GIS). Once generated, with appropriate tools for spatial analysis, the shapes of the surface catchments and the aquifers can be used to report both disaggregated (for the surface water basin or aquifer) and aggregated (agreement exists on either one).  
  
  
  
Step 3 Review existing arrangements for transboundary cooperation in water management and verify which transboundary waters are covered by a cooperation arrangement  
  
Some operational arrangements for integrated management of transboundary waters in place cover both surface waters and groundwaters. In such cases, it should be clear that the geographical extent of both is used to calculate the indicator value.  
  
In other cases, the area of application may be limited to a border section of the watercourse and in such cases only the corresponding area should be considered as potentially having an operational arrangement for calculating the indicator value.   
  
At the end of this step, it should be known which transboundary basins are covered by cooperation arrangements (and their respective areas).   
  
  
  
Step 4 Check which of the existing arrangements for transboundary cooperation in water management are operational  
  
  
  
The following check-list allows determining whether the cooperation arrangement on a particular basin or in relation to a particular co-riparian country is operational:  
  
  
  
- existence of a joint body, joint mechanism or commission for transboundary cooperation   
  
- regularity of formal communication in form of meetings   
  
- existence of joint or coordinated water management plan(s), or of joint objectives   
  
- regular exchange of information and data   
  
  
  
If any of the conditions is not met, the cooperation arrangement cannot be considered operational. This information is currently available in countries and can also be withdrawn from global, regional or basin reporting systems.  
  
  
  
Step 5   
  
Calculate the indicator value, that is, the area share by adding up the surface area in the country of those transboundary surface water basins or aquifers that are covered by an operational cooperation arrangement and dividing it by the total summed up area in the country of all transboundary basins (including aquifers), multiplied by 100 to obtain a percentage share."  
  
  
  
Disaggregation:  
  
Data would be most reliably collected at the national level. Basin level data can also be disaggregated to country level (for national reporting) and aggregated to regional and global level.  
  
  
  
Treatment of missing values:  
  
At country level  
  
In the case of spatial data: For the basin delineations, Digital Elevation Model information can be used to delineate surface water basin boundaries. For aquifers, geological maps can provide a basis for approximating aquifer extent. In the case of groundwater, uncertainty about transboundary nature remains unless investigations of hydraulic properties have been made. In the absence of administrative records, gaps about the cooperation arrangements are difficult to fill.  
  
  
  
At regional and global levels  
  
The indicator is not appropriate for countries without a terrestrial border, so notably island states will not be reporting a value on this indicator.  
  
International databases and inventories (as described in section 6) are available for reference in the absence of information reported by countries. Missing surface water basin extent can be extracted from Digital Elevation Models available globally. Global geological maps and maps of hydrogeology/groundwater potential also exist which could be used to approximate aquifer extent (surface area).  
  
Concerning agreements, consistency of information reported by co-riparian countries can be used to fill gaps in information about agreements and their operationality.  
  
  
  
Regional aggregates:  
  
Regional and global estimates will be obtained by summing up the total transboundary basin areas with arrangement and dividing the result by the total transboundary basin area of the countries. It means that the total transboundary basin area need to be reported at national level, in addition to the indicator value.   
  
  
  
The information collected with the reporting under the Water Convention can support disaggregation at basin level and distinguishing aquifers and river basins, and support aggregation at the global or regional level.   
  
  
  
Baseline assessment from global database can be performed at any desired geographical scale: sub-national, national, regional, basin scale, global, etc.  
  
  
  
Sources of discrepancies:  
  
As the computation of the indicator is based on the spatial information (“transboundary basin area”) and operationality of arrangements as the two basic components, differences can arise in difference of the computation of each of these components individually.  
  
  
  
Regarding both components, the Member States have the most up-to-date information, which can be supplemented by the data from various international projects and inventories, which contribute also to establishing a baseline globally.  
  
  
  
The difference on the value of transboundary basin area can arise from a different delineation of the transboundary water bodies, especially aquifers, or even the consideration of their transboundary nature as their identification and delineation can be based on different hydrogeological studies and can be updated, which is not necessarily reflected in international database.  
  
  
  
The difference in the consideration of the operationality of the arrangements may arise from not identifying the same arrangements or considering differently the four criteria that serve as the basis for the operationality classification:   
  
  
  
- existence of a joint body, joint mechanism or commission for transboundary cooperation   
  
- regularity of formal communication in form of meetings   
  
- existence of joint or coordinated water management plan(s), or of joint objectives   
  
- regular exchange of information and data   
  
  
  
A different interpretation in the object of application (only surface water or both surface water and groundwater) may constitute another reason.  
  
  
  
Collection of country input through validation mechanisms, notably the reporting under the Water Convention is expected to improve the consistency and accuracy of the information across the countries as the monitoring progresses."  
  
  
  
Data Sources  
  
Description:  
  
At the country level, ministries and agencies responsible for surface water and groundwater resources (depends on the country but commonly ministry of the environment, water, natural resources, energy or agriculture; institutes of water resources, hydrology or geology, or geological surveys) typically have the spatial information about the location and extent of the surface water basin boundaries and aquifer delineations (as Geographical Information Systems shapefiles). Information on existing arrangement and their operationality is also commonly available from the same institutions.  
  
  
  
Regular reporting contributing to the information collection  
  
Reporting under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) will also gather the information needed for the calculation of the indicator, especially on the cooperation arrangements, transboundary waters covered by them as well as operationality. The Convention’s regular reporting on transboundary water cooperation, involving both Parties and non-Parties to the Convention, will collect this information every 3 years as of 2017. The reporting covers trans-boundary rivers, lakes and ground waters. UNESCO IHP will contribute to the reporting on transboundary aquifers. More than 100 countries participate in the Water Convention’s activities. The United Nations Economic Commission for Europe acts as Secretariat for the Water   
  
  
  
Convention.  
  
Some countries already report to regional organizations on the advancement of transboundary water cooperation, and similar arrangements could be strengthened and facilitated.  
  
  
  
In the absence of available information at the national level global datasets on transboundary basins as well as about agreements and organizations for transboundary cooperation are available, which could be used in the absence of more detailed information, in the short term in particular.  
  
  
  
Delineations of transboundary basins  
  
In global databases, the most up-to-date delineations are available through the Transboundary Waters Assessment Programme (TWAP). TWAP covered 286 main transboundary rivers, 206 transboundary lakes and reservoirs and 199 transboundary aquifers. Relevant information have also been compiled for 592 transboundary aquifers by the UNESCO ISARM project.   
  
  
  
Cooperation arrangements  
  
Existence of treaties is available from the International Freshwater Treaties Database, maintained by Oregon State University (OSU). This was last updated to include all arrangements up to 2008. The treaty database includes in total 686 international freshwater treaties.   
  
Organizations for transboundary water cooperation: International River Basin Organization (RBO) Database detailed information about over 120 international river basin organizations, including bilateral commissions, around the world.   
  
  
  
Regional assessments describing and inventorying agreements have been undertaken, contributing to the baseline globally, for example, regional inventories of transboundary aquifers under the UNESCO-IHP   
  
ISARM.  
  
  
  
Collection process:  
  
Data are not so far included in the National Statistical Systems but the information needed to calculate the indicator is simple, does not require advanced monitoring capacities and is normally available to all countries.  
  
  
  
Spatial information (“transboundary basin area”) is normally available in ministries in charge of water resources. Regarding operationality of arrangement the data needed for calculating the indicator can be directly obtained from information from administrative records (Member States have records of cooperation arrangements).   
  
  
  
The limitations in terms of comparability of the results between countries are the same as the ones described in Section 12. However, a clear definition and consideration of the criteria as developed in the detailed methodology currently tested under the UN-Water GEMI initiative and that will be available to countries ensure a common reference for the countries.  
  
  
  
Moreover, the elements of the indicator are based on the main principles of customary international water law, also contained in the two UN conventions - Convention on the Law of the Non-navigational Uses of International Watercourses (New York, 1997) and the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992) – as well as the draft Articles on The Law of Transboundary Aquifers (2008; UN General Assembly resolutions 63/124 and 66/104).  
  
  
  
The proposed mechanism of reporting under the water Convention will allow also having sub-components of the indicator reported by countries, which will ensure both more confidence on the final indicator value (validation) and increased comparability.  
  
  
  
Data Availability  
  
Description:  
  
Data are not so far included in the National Statistical Systems but the information needed to calculate the indicator is simple, does not require advanced monitoring capacities and is normally available to all countries at the ministries or agencies responsible for water resources.  
  
  
  
Data is available for the 154 countries having territorial borders in a number of existing databases.   
  
  
  
Asia and Pacific: 39  
  
Africa: 47  
  
Latin America and the Caribbean: 22   
  
Europe, North America, Australia, New Zealand and Japan: 46  
  
  
  
Time series:  
  
NA  
  
  
  
Calendar  
  
Data collection:  
  
2016-2017 for reporting under the Water Convention  
  
  
  
Data release:  
  
Early 2018   
  
  
  
Data providers  
  
Data are not so far included in the National Statistical Systems but the information needed to calculate the indicator is simple, does not require advanced monitoring capacities and is normally available to all countries at the ministries or agencies responsible for water resources. Spatial information (“transboundary basin area”) is normally available in ministries in charge of water resources. The value of this component is relatively fixed although the precision may vary (especially on aquifers), and may require only limited update on the basis of improved knowledge. Regarding operationality of arrangement the data needed for calculating the indicator can be directly obtained from information from administrative records (Member States have records of cooperation arrangements).  
  
  
  
Data compilers  
  
UNECE and UNESCO-IHP Reporting under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) will also gather the information needed for the calculation of the indicator, especially on the cooperation arrangements, transboundary waters covered by them as well as operationality. The Convention’s regular reporting on transboundary water cooperation, involving both Parties and non-Parties to the Convention, will collect this information every 3 years as of 2017. The reporting covers transboundary rivers, lakes and groundwaters. UNESCO IHP will contribute to the reporting on transboundary aquifers. More than 100 countries participate in the Water Convention’s activities. The United Nations Economic Commission for Europe acts as Secretariat for the Water Convention. Some countries already report to regional organizations (e.g. the European Union or the Southern African Development Community) on the advancement of transboundary water cooperation, and similar arrangements could be strengthened and facilitated.  
  
  
  
References  
  
URL:  
  
http://www.unesco.org/new/en/ihp; http://www.unece.org/env/water/  
  
  
  
References:  
  
The methodology is established and is based on the main principles of customary international water law, also contained in the two UN conventions - Convention on the Law of the Non-navigational Uses of International Watercourses (New York, 1997) and the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992) – as well as the draft Articles on The Law of Transboundary Aquifers (2008; UN General Assembly resolutions 63/124 and 66/104).  
  
  
  
Convention on the Protection and Use of Transboundary Watercourses and International Lakes: a globalizing framework   
  
http://www.unece.org/env/water.html   
  
  
  
Reporting under the Water Convention   
  
http://www.unece.org/fileadmin/DAM/env/documents/2015/WAT/11Nov\_1719\_MOP7\_Budapest/ECE\_MP.WAT\_2015\_7\_reporting\_decision\_ENG.pdf  
  
  
  
GEMI – Integrated Monitoring of Water and Sanitation-related SDG Targets. Internet site. http://www.unwater.org/gemi/en/   
  
  
  
Global Environment Facility’s Transboundary Waters Assessment Project   
  
http://www.geftwap.org/   
  
  
  
Treaties on transboundary waters:   
  
Transboundary Freshwater Dispute Database (TFDD) at Oregon State University http://www.transboundarywaters.orst.edu/publications/atlas/index.html   
  
  
  
River Basin Organisations   
  
http://www.transboundarywaters.orst.edu/research/RBO/index.html   
  
  
  
A regional example: Status of transboundary water cooperation in the pan-European region: http://www.unece.org/env/water/publications/pub/second\_assessment.html   
  
  
  
Internationally Shared Aquifer Resources Management (UNESCO’s International Hydrological Programme): Regional inventories of transboundary groundwaters   
  
http://www.isarm.org/   
  
  
  
Transboundary Waters Assessment Programme   
  
http://www.geftwap.org/  
  
  
  
Related indicators as of February 2020  
  
1.4:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
2.3:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
7.1:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
15.9:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
16.3:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
16.6:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
16.7:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
Comments:  
  
Poverty (1.4); agriculture (2.3); energy (7.1); ecosystems (15.9); governance (16.3, 16.6 – 16.7)

Last updated: 11 July 2017  
  
  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.b: Support and strengthen the participation of local communities in improving water and sanitation management  
  
Indicator 6.b.1: Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management  
  
  
  
Institutional information  
  
  
  
Organization(s):  
  
  
  
World Health Organization (WHO)  
  
  
  
United Nations Environment Programme (UNEP)  
  
  
  
Organisation for Economic Co-operation and Development (OECD)  
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
  
  
The indicator assesses the percentage of local administrative units (as defined by the national government) that have an established and operational mechanism by which individuals and communities can meaningfully contribute to decisions and directions about water and sanitation management.  
  
  
  
The indicator Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management is currently being measured by the Proportion of countries with clearly defined procedures in law or policy for participation by service users/communities in planning program in water and sanitation management, and hygiene promotion and the Proportion of countries with high level of users/communities participating in planning programs in water and sanitation management, and hygiene promotion.  
  
  
  
Rationale:  
  
  
  
Defining the procedures in policy or law for the participation of local communities is vital to ensure the needs of all the community are met, including the most vulnerable and also encourages ownership of schemes which in turn contributes to their sustainability.  
  
  
  
A low value of this indicator would suggest that participation of local communities in water and sanitation management is low, whereas a high value would indicate high levels of participation, indicating greater ownership and a higher likelihood of sustainable delivery and management of water and sanitation services.  
  
  
  
Concepts:  
  
  
  
Stakeholder participation is essential to ensure the sustainability of water and sanitation management options over time, e.g. the choice of appropriate solutions for a given social and economic context, and the full understanding of the impacts of a certain development decision. Defining the procedures in policy or law for the participation of local communities is vital to ensure needs of all the community is met, including the most vulnerable and also encourages ownership of schemes which in turn contributes to their sustainability.  
  
  
  
Local administrative units refers to non-overlapping sub-districts, municipalities, communes, or other local community-level units covering both urban and rural areas to be defined by the government.   
  
  
  
Policies and procedures for participation of local communities in water and sanitation management would define a formal mechanism to ensure participation of users in planning water and sanitation activities.   
  
  
  
A policy or procedure is considered to be established if the mechanism for participation of local communities is defined in law or has been formally approved and published. It is considered to be operational if the policy or procedure is being implemented, with appropriate funding in place and with means for verifying that participation took place.  
  
  
  
‘Water and sanitation’ includes all areas of management related to each of the targets under SDG 6, namely: water supply (6.1), sanitation and hygiene (6.2), wastewater treatment and ambient water quality (6.3), efficiency and sustainable use (6.4), integrated water resources management (6.5) and water-related ecosystems (6.6).  
  
  
  
Comments and limitations:  
  
  
  
Data on local administrative units with established and operational policies and procedures for local participation is being collected through the current cycle of GLAAS, and will be available by end-2016. Until then, the presence of policies and procedures as reported at the national level for different subsectors will be reported.  
  
  
  
Additional data, including data measuring local participation from the OECD Water Governance Indicators and administrative data, will be progressively included in the calculation of the indicator as they become available.  
  
  
  
Methodology  
  
  
  
Computation Method:  
  
  
  
The UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) questionnaire provides information on whether there are “clearly defined procedures in laws or policies for participation by service users (e.g. households) and communities in planning programs”. For countries that have data available from the local administrative unit level, they are asked to provide data on the number of local administrative units for which policies and procedures for local participation (i) exist, and (ii) are operational, as well as (iii) the number of local administrative units assessed, and (iv) the total number of units in the country. The indicator is computed as (ii) the number of local admin units with operation policies and procedures for local participation divided by (iv) the total number of local administrative units in the country.  
  
  
  
Both numerator and denominator will be obtained through the GLAAS survey for the 2016-2017 cycle.  
  
  
  
Treatment of missing values:  
  
  
  
At country level  
  
  
  
Due to the highly country- and context-specific nature of the indicator, no estimates are produced for countries that are missing data.  
  
  
  
At regional and global levels  
  
  
  
Operational mechanism by which individuals and communities can meaningfully contribute to water and sanitation management then the country will be excluded from the regional and global estimates for this indicator.   
  
  
  
Global and regional estimates for a related indicator on the presence and use of participation policies and procedures at the national level for different water subsectors are also derived to support the target indicator. Similarly, countries with missing values are excluded from global and regional analysis for this indicator.  
  
  
  
Regional aggregates:  
  
  
  
For global and regional aggregates, the percentage of local administrative units that have a defined and operational mechanism by which individuals and communities can meaningfully contribute to decisions and directions about water and sanitation management will be averaged among countries, with each country’s percent value weighted based on total country population for the data year, as a proportion of the global population.  
  
  
  
Sources of discrepancies:  
  
  
  
This indicator will be generated by countries, thus no differences in global and national figures are expected.  
  
  
  
Methods and guidance available to countries for the compilation of the data at the national level:  
  
  
  
National governments participating in GLAAS fill out the country survey, preferably supported by a multi-stakeholder review. Although one ministry leads the process, it is often the case that many different ministries and departments must be involved in the process in order to obtain the data required to complete the questionnaire. A GLAAS national focal person supports the lead ministry to coordinate data collection, to compile the national response to the questionnaire, and to lead on the process of data validation. GLAAS survey documents for the current cycle can be found at the following link: http://www.who.int/water\_sanitation\_health/monitoring/investments/glaas-2017-survey/en/   
  
The UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) provides information on governance, monitoring, human resources, and financing in the water, sanitation, and hygiene (WASH) sector. The UN-Water GLAAS survey is currently conducted on a biennial basis, led by WHO and has completed three full cycles (2009/2010, 2011/2012, and 2013/2014), as well as a pilot conducted in 2008. GLAAS survey documents for the current cycle of data collection (2016/2017) can be found at the following link: http://www.who.int/water\_sanitation\_health/monitoring/investments/glaas-2017-survey/en/  
  
  
  
Quality assurance:  
  
  
  
Once received, the country submission undergoes a thorough data validation process, which is often an iterative process requiring communication and feedback with regional and country counterparts. Quality of the submission is also assessed through an analysis of data collected on country processes (number of ministries involved, whether a national meeting was held to support the filling of the questionnaire, stakeholder validation, use of documentation, etc.) as well as supporting documentation provided. In addition, an external validation with key informants is conducted, in which WASH experts who have not participated in the GLAAS process respond to selected questions from the survey for a specific country within their area of expertise, and agreement with country responses is evaluated.  
  
  
  
Data submitted through GLAAS are endorsed by the national government prior to submission. A form (http://www.who.int/entity/water\_sanitation\_health/monitoring/investments/glaas-consent-form-2016.doc?ua=1) providing consent to WHO for the release and publication of the country data is signed and submitted along with the filled survey.  
  
  
  
Data Sources  
  
  
  
Description:  
  
  
  
The UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) provides information on governance, monitoring, human resources, and financing in the water, sanitation, and hygiene (WASH) sector. The UN-Water GLAAS survey is currently conducted on a biennial basis, led by WHO, and collected data from 94 countries (predominantly low and lower-middle income countries) in the most recent cycle in 2013-2014. The scope of the question on community and user participation has been expanded beyond WASH for the 2016-17 GLAAS cycle to address all targets in SDG 6, including water quality, water rights/allocation, water resource management, and the status of water-related ecosystems. GLAAS has completed three full cycles (2009-2010, 2011-2012, and 2013-2014), as well as a pilot conducted in 2008.   
  
  
  
National governments participating in the GLAAS survey fill out the questionnaire, preferably supported by a multi-stakeholder review. Although one ministry leads the process, it is often the case that many different ministries and departments must be involved in the process in order to obtain the data required to complete the questionnaire. A GLAAS national focal person supports the lead ministry to coordinate data collection, to compile the national response to the questionnaire, and to lead on the process of data validation.  
  
  
  
The data will be complemented by Integrated Water Resources Management (IWRM) reporting in SDG target 6.5 (for wastewater and water quality, water efficiency, water resource management, and the status of water-related ecosystems) (UNEP 2016). A key component of IWRM is community participation and management of water resources at the local level. The analysis of IWRM has been done in the past by UN-Water in 2008 (led by UN-DESA) and in 2012 (led by UNEP, UNDP, GWP and SIWI) as requested by the UN Commission for Sustainable Development (UN-Water 2008, 2012).  
  
  
  
The OECD Water Governance Initiative (WGI), a technical platform gathering 100+ members from the public, private and non-for-profit sectors, is currently developing a set of Water Governance Indicators, within the implementation strategy of the OECD Principles on Water Governance (OECD 2015a). The Water Governance Indicators are expected to be able to provide additional information on local participation on the basis of an indicators system proposed in OECD (2015b) for measuring “stakeholder engagement for inclusive water governance”. An indicator providing metrics on local participation will be developed and tested by 2017. Data will be made available through interactive platforms and databases in a format to foster policy dialogue and peer learning by 2018. A dedicated publication on “Water Governance at a Glance” will be launched at the 8th World Water Forum in Brasilia (2018).  
  
  
  
Collection process:  
  
  
  
National governments participating in the GLAAS survey fill out the questionnaire, preferably supported by a multi-stakeholder review. Although one ministry leads the process (e.g. Ministry of Water, Ministry of Environment, etc. depending on country), it is often the case that many different ministries and departments must be involved in the process in order to obtain the data required to complete the questionnaire. A GLAAS national focal person supports the lead ministry to coordinate data collection, to compile the national response to the questionnaire, and to lead on the process of data validation. For each GLAAS submission, information on the country processes are collected (number of ministries involved, whether a national meeting was held to support the filling of the questionnaire, stakeholder validation, use of documentation, etc.) Once received, the country submission undergoes a thorough data validation process, which is often an iterative process requiring communication and feedback with regional and country counterparts.  
  
  
  
Countries are also requested to provide consent to publish individual, validated data responses as supplied to GLAAS. Thus through the data collection, validation and consultation processes, the results are expected to be comparable and no further adjustments are foreseen.  
  
  
  
Data Availability  
  
  
  
Description:  
  
  
  
Asia and Pacific: Most countries (at least 50% of the countries covering 60% of the population from the region)  
  
Africa: Some countries (approximately 50% of the countries covering 50% of the population from the region)  
  
Latin America and the Caribbean: Most countries (at least 60% of the countries covering 80% of the population from the region)  
  
Europe, North America, Australia, New Zealand and Japan: Most countries (at least 60% of the countries covering 60% of the population from the region)  
  
  
  
Please note that these reflect data on presence of policies and procedures for local participation at the national level. Data at the local administrative unit level is being collected through the current cycle of   
  
  
  
GLAAS and through administrative data that will be progressively included in the calculation of the indicator (cf. 7.1, 10.1, and 10.2).  
  
  
  
Time series:  
  
  
  
Time series of parameters under the indicator are available for 2008, 2010, 2012, and 2014.   
  
  
  
Calendar  
  
  
  
Data collection:  
  
  
  
The current round of UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) has been launched and data will be available by end-2016. (From NA to NA)  
  
  
  
Data release:  
  
  
  
Q1 2017   
  
  
  
Data providers  
  
  
  
Description:  
  
  
  
Ministries with responsibilities related to water supply and sanitation, agriculture, water resources development and management, and environment  
  
  
  
Data compilers  
  
  
  
Name:  
  
  
  
WHO, OECD and UNEP  
  
  
  
Description:  
  
  
  
WHO, with support from OECD and UNEP  
  
  
  
References  
  
  
  
URL:  
  
  
  
http://www.who.int/water\_sanitation\_health/glaas/en/  
  
http://www.unep.org/  
  
http://www.oecd.org/env/watergovernanceprogramme.htm  
  
  
  
References:  
  
  
  
UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water. http://www.who.int/water\_sanitation\_health/glaas/en/  
  
  
  
OECD (2015a), OECD Principles on Water Governance, available at: https://www.oecd.org/gov/regional-policy/OECD-Principles-on-Water-Governance-brochure.pdf  
  
  
  
OECD (2015b), Stakeholder Engagement for Inclusive Water Governance, OECD Studies on Water, OECD Publishing, Paris., http://dx.doi.org/10.1787/9789264231122-en  
  
  
  
UN-Water 2008 : Status Report on IWRM for CSD-16, http://www.unwater.org/publications/publications-detail/en/c/206480/UNEP-DHI   
  
  
  
UN-Water 2012: Status Reports on IWRM. http://www.unwater.org/publications/status-report-on-integrated-water-resources-management/en/   
  
  
  
Data from the 2012 Survey on the Application of Integrated Approaches to Water Resources Management. http://www.unepdhi.org/rioplus20   
  
  
  
UNEP 2016. Degree of implementation of integrated water resources management. Draft survey to support SDG indicator 6.5.1 http://www.unepdhi.org/whatwedo/gemi   
  
  
  
OECD 2015. Stakeholder Engagement for Inclusive Water Governance. http://www.oecd-ilibrary.org/governance/stakeholder-engagement-for-inclusive-water-governance\_9789264231122-en  
  
  
  
Related indicators as of February 2020  
  
  
  
6.5:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
  
  
15.9:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
  
  
Comments:  
  
  
  
6.5 (implement integrated water resources management at all levels, including transboundary cooperation as appropriate) 15.9 (integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts)

Last updated: 18 November 2016  
  
  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally  
  
Indicator 6.3.1: Proportion of domestic and industrial wastewater flows safely treated  
  
  
  
Institutional information  
  
  
  
Organization(s):  
  
World Health Organization (WHO)  
  
United Nations Human Settlements Programme (UN-HABITAT)  
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
Proportion of wastewater generated by households and by economic activities which is safely treated based on treatment ladders as defined by the SEEA: (http://unstats.un.org/unsd/envaccounting/water.asp, and International Recommendations for Water Statistics and IRWS: http://unstats.un.org/unsd/envaccounting/irws/irwswebversion.pdf) compared to total wastewater generated by households and economic activities.   
  
  
  
This indicator covers households and the entire economy, and builds on the monitoring framework of JMP, UNSD/UNEP Water Questionnaire for non OECD/Eurostat countries, OECD/Eurostat Questionnaire for OECD countries, AQUASAT, IBNET. Statistical methods for measurement of wastewater treatment is aligned with the SEEA21 statistical standard and associated definitions, classifications and treatment categories (Encompasses all wastewater generated and treated by the economy. Treatment Categories will be consistent, as much as possible within the context of global monitoring purposes, with those defined in the SEEA (http://unstats.un.org/unsd/envaccounting/water.asp), and International Recommendations for Water Statistics (IRWS: http://unstats.un.org/unsd/envaccounting/irws/irwswebversion.pdf)  
  
  
  
In addition, combining UNIDO industries database (http://stat.unido.org/) ISIC standard Classification system ( http://unstats.un.org/unsd/publication/seriesM/seriesm\_4rev4e.pdf ), will allow for data to be disaggregated for industrial/commercial wastewater into various economic activities, as well as differentiate hazardous industries from the rest. USEPA has harmonized hazardous waste classification with EU regulations compliment ISIC codes for all waste classes. (www.epa.ie/pubs/reports/waste/stats/wasteclassification/EPA\_Waste\_Classification\_2015\_Web.pdf)  
  
  
  
The household portion of wastewater is the same indicator as 6.2.1, and the monitoring of that will be interlinked to JMP monitoring for 6.2.1. Over the last 25 years the JMP has established global norms and standards for monitoring drinking water, sanitation and hygiene. The proposed 6.2.1. indicator builds on these and was developed following extensive consultations with sector experts. Major international consultations took place in 2011 and 2012, as well as many regional and country consultations in various parts of the world.  
  
  
  
Existing global norms and standards and technical recommendations for SDG monitoring are documented here: http://www.wssinfo.org/fileadmin/user\_upload/resources/Methodological-note-on-monitoring-SDG-targets-for-WASH-and-wastewater\_WHO-UNICEF\_8October2015\_Final.pdf.  
  
  
  
Rationale:  
  
Purpose and rationale for this indicator can also be found in the methods document: http://www.wssinfo.org/post-2015-monitoring/ and summarised in the following methodological note (p12): http://www.wssinfo.org/fileadmin/user\_upload/resources/Methodological-note-on-monitoring-SDG-targets-for-WASH-and-wastewater\_WHO-UNICEF\_8October2015\_Final.pdf  
  
  
  
Concepts:  
  
See above. Global norms and standards and technical recommendations for SDG monitoring are documented here: http://www.wssinfo.org/fileadmin/user\_upload/resources/Methodological-note-on-monitoring-SDG-targets-for-WASH-and-wastewater\_WHO-UNICEF\_8October2015\_Final.pdf.  
  
  
  
System of Environmental and Economic Accounting for Water, adopted by Statistical Commission in 2014. This accounting structure means that these activities cover the whole economy and are considered for each industry, which are defined according to the International Standard Industrial Classification of all Economic Activities (ISIC), and covering 1) abstraction and distribution of water, 2) discharge, reuse and treatment of wastewater, and 3) consumption and returns of water back to the environment, in this accounting structure, disaggregated by industry in a standardised way. Economic activities by ISIC broadly covers agriculture, hazardous industries and other economic activities  
  
  
  
Comments and limitations:  
  
The main issue regarding safely managed drinking water services will be comparability of data on the definition of what is considered safe treatment. Although there are international guidelines and standards, their compliance by countries is not internationally binding. Countries can set their own standards which can vary from international norms and standards. For this reason, country data may not follow the international standard that JMP likes to follow for its global monitoring purposes.   
  
  
  
Having said the above, using MDG experiences of data reconciliation, and working collaboratively with JMP on this will help reconciling definitional discrepancies and hence variations in estimates. This vast experience in dealing with such issues will be very useful in dealing with the above issues for the SDG period.  
  
  
  
Methodology  
  
  
  
Computation Method:  
  
The calculation of the indicator value as derived from the framework is the amount treated (off-site and on-site) divided by the total amount of waste produced. Data on treatment of domestic wastewater will come from the multi- purpose indicator 6.2.1. Data on volumes of industrial wastewater can be estimated from inventories of industries, which will be available in the majority of Member States disaggregated by ISIC classifications. The breakdown of treated wastewater can be calculated based on compliance records, related to national standards. Unless verified otherwise, through audited compliance records, the waste generated will be considered untreated.  
  
  
  
Disaggregation:  
  
Since this indicator is disaggregated for households and non-households (industrial and commercial establishments, as per the classification of ISIC Rev4); more can be found on the methods note: http://www.wssinfo.org/fileadmin/user\_upload/resources/Methodological-note-on-monitoring-SDG-targets-for-WASH-and-wastewater\_WHO-UNICEF\_8October2015\_Final.pdf.  
  
  
  
Treatment of missing values:  
  
  
  
At country level  
  
The calculation of the indicator value as derived from the framework is the amount treated (off-site and on-site) divided by the total amount of waste produced. Data on treatment of domestic wastewater will come from the multi- purpose indicator 6.2.1. Data on volumes of industrial wastewater can be estimated from inventories of industries, which will be available in the majority of Member States disaggregated by ISIC classifications. The breakdown of treated wastewater can be calculated based on compliance records, related to national standards. Unless verified otherwise, through audited compliance records, the waste generated will be considered untreated.  
  
At regional and global levels  
  
No data is published for countries for which we couldn't find country data  
  
  
  
Regional aggregates:  
  
See methods note mentioned above and 11.2 above.  
  
  
  
Sources of discrepancies:  
  
WHO is required by World Health Assembly resolution to consult on all WHO statistics, and seek feedback from countries on data about countries and territories. Before publishing all JMP estimates undergo rigorous country consultations facilitated by WHO and UNICEF country offices. Often these consultations give rise to in-country visits, and meetings about data reconciliations.  
  
  
  
Data Sources  
  
Description:  
  
Preliminary estimates are available for 140 countries for 6.2.1, which is the same as the household part of this indicator: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2016/02/11/090224b084172a75/1\_0/Original/The0costs0of0m0iene000data0catalog.xlsx.  
  
  
  
Since the publication of this, joint searches with JMP found national data available for most countries of the world. However extensive data from various sources could be combined from i) UNSD-UNEP questionnaire: http://unstats.un.org/unsd/environment/questionnaire.htm; ii) OECD: https://data.oecd.org/water/waste-water-treatment.htm. Iii) AQUASTAT: http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en, iv) IBNET: https://www.ib-net.org/. v) GWI: https://www.globalwaterintel.com/.  
  
  
  
Collection process:  
  
As mentioned earlier, data is collected directly from country sources, and following established method, estimates are shred with countries to receive their feedback before publication. See 6.1 above for more details.  
  
  
  
Data Availability  
  
Description:  
  
1. Although classified ahead of the 3rd IAEG meeting as Tier III indicator showing needing methodological developments, as we showed at that meeting that this indicator should be classified as a tier I indicator as it has established methodology, following international standards, as well as it has extensive data coverage for most countries for it to be a solid SDG indicator. We also have had since 3rd IAEG meeting extensive discussions with several countries about this indicator, including IAEG member countries.   
  
  
  
2. Most countries of the world, including the MDG regions, covering 90% of the global population (2010 onwards), as well as 50% of the countries of the world, covering at least 50% of the global population, including all MDG regions, for 2000-2009 period.   
  
  
  
3. Preliminary estimates are available for 140 countries for 6.2.1, which is the same as the household part of this indicator: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2016/02/11/090224b084172a75/1\_0/Original/The0costs0of0m0iene000data0catalog.xlsx. Since the publication of the report above, WHO and UNHABITAT have been collecting data directly from country sources, and have now data on treatment of wastewater from majority of countries of the world, many of which also provide time series data.   
  
  
  
4. Following further testing, a revised SDG baseline estimate will be available soon, along with estimates for other parts of this wastewater indicator, i.e. industrial and commercial parts broken down by economic activities following SEEA definitions and standards.   
  
  
  
5. For links to a few data sources mentioned in Q11 below: i) UNSD-UNEP questionnaire: http://unstats.un.org/unsd/environment/questionnaire.htm; ii) OECD: https://data.oecd.org/water/waste-water-treatment.htm. Iii) AQUASTAT: http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en, iv) IBNET: https://www.ib-net.org/. v) GWI: https://www.globalwaterintel.com/."  
  
  
  
Time series:  
  
WHO and UNHABITT plans to publish its first SDG baseline report with 2015 estimate, and build a time series as we move into the SDG period. (From NA to NA)  
  
  
  
Calendar  
  
Data collection:  
  
Started data collection and will run through the beginning of 2017. (From NA to NA)  
  
  
  
Data release:  
  
The baseline SDG report is due mid-2017 to feed into the SG’s report to be released in July 2017. (The baseline SDG report is due mid-2017 to feed into the SG’s report to be released in July 2017. )  
  
  
  
Data providers  
  
National statistics offices, Ministries of water, sanitation, health, environment. Regulators of sanitation services.  
  
  
  
Data compilers  
  
WHO and UNHABITAT  
  
  
  
References  
  
URL:  
  
www.wssinfo.org (website to be enhanced to accommodate wastewater data, as JMP sanitation indicator also to address wastewater part)  
  
  
  
References:  
  
  
  
1. The latest data from 140 countries on the use of safely managed sanitation services, which is the same as domestic part of wastewater indicator, published in the report that was produced in collaboration between the World Bank and the JMP. The report and data sources could be found at this link: http://www.worldbank.org/en/topic/water/publication/the-costs-of-meeting-the-2030-sustainable-development-goal-targets-on-drinking-water-sanitation-and-hygiene   
  
  
  
2. Additionally, as explained in the methods note (see link above), other data from international databases like UNSD-UNEP, OECD, EUROSTAT, AQUASTAT (FAO), IBNET (World Bank), Global Water Intelligence, as well as data from national regulators, and other parts of national statistical systems from around the world will be integrated for monitoring 6.3.1. Combining the various data sources, it is believed that data from over 180 countries could be used for global reporting purposes.   
  
  
  
3. This indicator is classified as a Tier I indicator, as it is conceptually clear, has an established methodology as well as standards, and data are regularly produced by almost all countries that can be used for global reporting."  
  
  
  
Related indicators as of February 2020  
  
6.2:  
  
(a) Proportion of total agricultural population with ownership or secure rights over agricultural land, by sex; and (b) share of women among owners or rights-bearers of agricultural land, by type of tenure  
  
Comments:  
  
Target 6.2

Last updated: 11 July 2017  
  
  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.a: By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies  
  
Indicator 6.a.1: Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan  
  
  
  
Institutional information  
  
  
  
 Organization(s):   
  
  
  
World Health Organization (WHO)  
  
  
  
United Nations Environment Programme (UNEP)  
  
  
  
Organisation for Economic Co-operation and Development (OECD)  
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
  
  
Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan is defined as the proportion of total water and sanitation-related Official Development Assistance (ODA) disbursements that are included in the government budget.  
  
  
  
Rationale:  
  
  
  
The amount of water and sanitation-related Official Development Assistance (ODA) is a quantifiable measurement as a proxy for “international cooperation and capacity development support” in financial terms. It is essential to be able to assess ODA in proportion with how much of it is included in the government budget to gain a better understanding of whether donors are aligned with national governments while highlighting total water and sanitation ODA disbursements to developing countries over time.   
  
  
  
A low value of this indicator (near 0%) would suggest that international donors are investing in water and sanitation related activities and programmes in the country outside the purview of the national government. A high value (near 100%) would indicate that donors are aligned with national government and national policies and plans for water and sanitation.  
  
  
  
Concepts:  
  
  
  
“International cooperation and capacity-building support” implies aid (most of it quantifiable) in the form of grants or loans by external support agencies. The amount of water and sanitation-related Official Development Assistance (ODA) can be used as a proxy for this, captured by OECD Creditor Reporting System (CRS). ODA is defined as flows of official financing administered with the promotion of the economic development and welfare of developing countries as the main objective, and which are concessional in character with a grant element of at least 25 per cent (using a fixed 10 per cent rate of discount). By convention, ODA flows comprise contributions of donor government agencies, at all levels, to developing countries (“bilateral ODA”) and to multilateral institutions. ODA receipts, from a recipient perspective, comprise disbursements by bilateral donors and multilateral institutions. Lending by export credit agencies—with the pure purpose of export promotion—is excluded (see http://www.oecd.org/dac/stats/officialdevelopmentassistancedefinitionandcoverage.htm).  
  
  
  
“Developing countries” refer to countries, which are eligible to receive official development assistance (see http://www.oecd.org/dac/stats/daclist.htm). This limits the scope of reporting to those countries receiving water and sanitation ODA, and the number of such countries is expected to decrease going forward.  
  
  
  
Water and sanitation-related activities and programmes include those for water supply, sanitation and hygiene (WASH) (targets 6.1, 6.2), wastewater and water quality (6.3), water efficiency (6.4), water resource management (6.5), and water-related ecosystems (6.6). As per target 6.a wording, it includes activities and programmes for water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.   
  
  
  
A government coordinated spending plan is defined as a financing plan/budget for the water and sanitation sector, clearly assessing the available sources of finance and strategies for financing future needs.  
  
  
  
Comments and limitations:  
  
  
  
Data on water and sanitation-related ODA included in the government budget will be available by end-2016 with the current cycle of UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) data. Until then, total water and sanitation-related ODA (denominator) will be reported. Total water and sanitation-related ODA will continue to be reported as an additional indicator going forward.  
  
  
  
In addition, the proportion of ODA channelled through the government treasury will be reported as an additional indicator. ODA channelled through treasury indicates a high level of cooperation and alignment between donors and national government in which the donors channel funds through the national budget process.   
  
  
  
The OECD Creditor Reporting System (CRS) currently disaggregates ODA for the water and sanitation among several categories including: sector policy and administration, water resources protection, large and basic water and sanitation systems, river basin infrastructure, waste management, agricultural water resources, and education and training. While these categories do not align directly with the target areas of SDG 6 individually, which limits the disaggregation of ODA among the SDG target areas, the combined ODA from these categories does align with a majority of the reported ODA to the water sector.  
  
  
  
As the numerator and denominator come from different sources, there is the possibility of different underlying assumptions regarding what should be included/excluded in the ODA figures. This could lead to situations in which the proportion of ODA included in government budget is greater than 1 (100%) if total ODA reported to OECD is lower than ODA reported to be included the budget. To guard against this possibility, the OECD will supply GLAAS with the reported ODA figures, broken down to the project level, so that respondents can match these with their on-budget project data.   
  
  
  
ODA represents only one aspect of international cooperation. To capture other dimensions, additional supporting indicators are available, including indicators for the Collaborative Behaviours identified by the Sanitation and Water for All (SWA) partnership. Each behaviour has one or two key indicators for governments and for development partners. If the behaviours are jointly adapted by governments and development partners, long-term sector performance and sustainability would improve. For additional information on the Collaborative Behaviours see: http://sanitationandwaterforall.org/about/the-four-swa-collaborative-behaviours/  
  
  
  
Methodology  
  
  
  
Computation Method:  
  
  
  
The indicator is computed as the proportion of total water and sanitation-related ODA that is included in the government budget, i.e. the amount of water and sanitation-related ODA in the government budget divided by the total amount of water and sanitation-related ODA.  
  
  
  
The numerator on water and sanitation-related ODA in the government budget will be obtained from the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) survey for the 2016-2017 cycle. The question on external funding collects data on the amount of donor funds that were included in government budget. Data for 2015 ODA disbursements through GLAAS will be available by end-2016. The scope of the question on external funding has been expanded beyond WASH for the 2016-17 cycle to address all targets under SDG 6, including wastewater and water quality, water efficiency, water resource management, and water-related ecosystems.  
  
  
  
The denominator on total water and sanitation-related ODA disbursements will be obtained through OECD Creditor Reporting System (CRS) (purpose codes 14000-series for the water sector and purpose code 31140 for agricultural water resources). Data on ODA disbursements for 2015 will be made available through CRS in December 2016.  
  
  
  
Disaggregation:  
  
  
  
Subsector disaggregation (basic vs. large systems)  
  
  
  
Treatment of missing values:  
  
  
  
At country level  
  
  
  
Due to the highly country- and context-specific nature of ODA disbursements and whether they are aligned with national government plans, no estimates are produced for countries that are missing data.  
  
  
  
At regional and global levels  
  
  
  
If no data is provided for the amount of ODA included in the budget, then the country is excluded from the regional and/or global analysis.  
  
  
  
Regional aggregates:  
  
  
  
Global and regional aggregates for ODA are derived based on summation of recipient country ODA disbursement for the water sector (purpose codes 14000- series) and agricultural water resources (purpose code 31140) from the OECD Creditor Reporting System.   
  
  
  
Global and regional proportions of ODA disbursements as part of a government budget are derived for countries based on a summation of ODA for the water sector that is included in the budget divided by a summation of total ODA for water sector. The calculation of global and regional aggregates would only be performed for those countries reporting the amount of ODA for the water sector that is included in the budget. If no data is provided for the amount of ODA in the budget, then the country is excluded from the regional and/or global analysis.  
  
  
  
Sources of discrepancies:  
  
  
  
There may be differences in how much development aid is reported by a recipient country and the amount of ODA disbursed to that country as reported by the OECD-CRS. While OECD captures a significant amount of the aid flows (as reported by external donors) to the water and sanitation sector, countries may receive development aid for water and sanitation from national and international donors that do not report to the OECD-CRS data system. Other differences may occur if recipient countries define development aid more or less rigorously than OECD’s definition of ODA, or use different timeframes (e.g. fiscal year instead of calendar year) to report aid flows. In order to ensure data is as consistent as possible, the OECD will supply the reported ODA figures broken down to the project level, so that respondents can match these with their on-budget project data.  
  
  
  
Methods and guidance available to countries for the compilation of the data at the national level:  
  
  
  
Questionnaires for providers of development cooperation are available at the following link: http://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/ The data included in the indicator are ODA flows from all donors to developing countries eligible for ODA for the water sector (water and sanitation (purpose codes 14000- series), agricultural water resources (purpose code 31140), flood prevention/control (purpose code 41050), and hydroelectric power plants (purpose code 23220)).  
  
  
  
The OECD Development Assistance Committee (DAC) has been collecting data on aid flows since 1973 through the OECD Creditor Reporting System based on a standard methodology and agreed definitions from member countries and other aid providers. The data are generally obtained on an activity level, and include numerous parameters to allow disaggregation by provider and recipient country, by type of finance, and by type of resources provided. Data are available for essentially all high-income countries as bilateral donors, and for an increasing number of middle-income aid providers, as well as multi-lateral lending institutions. Methodology on ODA data collection by OECD can be found here: http://www.oecd.org/dac/stats/methodology.htm.   
  
  
  
  
  
  
  
  
  
Quality assurance:  
  
  
  
Data are collected using a converged reporting system whereby bilateral and multilateral providers of development co-operation use a single file format (Creditor Reporting System – CRS) to report at item level on all flows of resources to developing countries. Item-level reporting is validated against key aggregates also reported by donors and then serves as the basis for producing various other aggregate statistics. For further details, see: http://www.oecd.org/dac/stats/methodology.htm   
  
  
  
A statistical reporter is responsible for the collection of DAC statistics in each providing country/agency. This reporter is usually located in the national aid agency, Ministry of Foreign Affairs or Finance etc.  
  
  
  
Data Sources  
  
  
  
Description:  
  
  
  
The UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) provides information on governance, monitoring, human resources, and financing in the water, sanitation, and hygiene (WASH) sector. The UN-Water GLAAS survey is currently conducted on a biennial basis, led by WHO, and collected data from 94 countries (predominantly low and lower-middle income countries) in the most recent cycle in 2013-2014. The scope of the question on external funding has been expanded beyond WASH for the 2016-17 GLAAS cycle to include wastewater and water quality, water efficiency, water resource management, and the status of water-related ecosystems. GLAAS has completed three full cycles (2009-2010, 2011-2012, and 2013-2014), as well as a pilot conducted in 2008.   
  
  
  
National governments participating in the GLAAS survey fill out the questionnaire, preferably supported by a multi-stakeholder review. Although one ministry leads the process, it is often the case that many different ministries and departments must be involved in the process in order to obtain the data required to complete the questionnaire. A GLAAS national focal person supports the lead ministry to coordinate data collection, to compile the national response to the questionnaire, and to lead on the process of data validation.  
  
  
  
The OECD Development Assistance Committee (DAC) has been collecting data on aid flows since 1973 through the OECD Creditor Reporting System based on a standard methodology and agreed definitions from member countries and other aid providers. The data are generally obtained on an activity level, and include numerous parameters to allow disaggregation by provider and recipient country, by type of finance, and by type of resources provided. Data are available for essentially all high-income countries as bilateral donors, and for an increasing number of middle-income aid providers, as well as multi-lateral lending institutions. Methodology on ODA data collection by OECD can be found here: http://www.oecd.org/dac/stats/methodology.htm  
  
  
  
The data will be complemented by Integrated Water Resources Management (IWRM) reporting in SDG target 6.5 (for wastewater and water quality, water efficiency, water resource management, and the status of water-related ecosystems) (UNEP 2016). The analysis of IWRM has been done in the past by UN-Water in 2008 (led by UN-DESA) and in 2012 (led by UNEP, UNDP, GWP and SIWI) as requested by the UN Commission for Sustainable Development (UN-Water 2008, 2012).  
  
  
  
Collection process:  
  
  
  
National governments participating in the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) survey fill out the questionnaire, preferably supported by a multi-stakeholder review. Although one ministry leads the process (e.g. Ministry of Water, Ministry of Environment, etc. depending on country), it is often the case that many different ministries and departments must be involved in the process in order to obtain the data required to complete the questionnaire. A GLAAS national focal person supports the lead ministry to coordinate data collection, to compile the national response to the questionnaire, and to lead on the process of data validation. For each GLAAS submission, information on the country processes is collected (number of ministries involved, whether a national meeting was held to support the filling of the questionnaire, stakeholder validation, use of documentation, etc.). Once received, the country submission undergoes a thorough data validation process, which is often an iterative process requiring communication and feedback with regional and country counterparts.  
  
  
  
Countries are also requested to provide consent to publish individual, validated data responses as supplied to GLAAS. Thus through the data collection, validation and consultation processes, the results are expected to be comparable and no further adjustments are foreseen.  
  
  
  
Data Availability  
  
  
  
Description:  
  
  
  
Asia and Pacific: Most countries (at least 80% of the countries covering 90% of the population from the region)  
  
Africa: Most countries (at least 80% of the countries covering 90% of the population from the region)  
  
Latin America and the Caribbean: Most countries (at least 80% of the countries covering 90% of the population from the region)  
  
Europe, North America, Australia, New Zealand and Japan: Some countries  
  
Please note that these reflect availability of data on total water and sanitation ODA. Data on proportion included in government budget will be available through the current cycle of GLAAS (cf. 7.1, 10.1, and 10.2).  
  
  
  
Time series:  
  
  
  
Time series of parameters under the indicator are available for 2008, 2010, 2012, and 2014.  
  
  
  
Calendar  
  
  
  
Data collection:  
  
  
  
The current round of GLAAS has been launched and data for 2015 ODA disbursements channelled through national government budgets will be available by end-2016. OECD data on ODA disbursements for 2015 will be made available through CRS in December 2016. (From NA to NA)  
  
  
  
Data release:  
  
  
  
Q1 2017  
  
  
  
Data providers  
  
  
  
Description:  
  
  
  
Ministries with responsibilities related to finance, water supply and sanitation, agriculture, water resources development and management, environment, and foreign affairs  
  
  
  
Data compilers  
  
  
  
Name:  
  
  
  
WHO and OECD, UNEP  
  
  
  
Description:  
  
  
  
WHO and OECD, with support from UNEP  
  
  
  
References  
  
  
  
URL:  
  
  
  
http://www.who.int/water\_sanitation\_health/glaas/en/  
  
http://www.unep.org/  
  
http://www.oecd.org/dac/stats/data.htm  
  
  
  
References:  
  
  
  
- UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water. http://www.who.int/water\_sanitation\_health/glaas/en/  
  
  
  
- UN-Water 2008: Status Report on IWRM for CSD-16, http://www.unwater.org/publications/publications-detail/en/c/206480/UNEP-DHI   
  
  
  
- UN-Water 2012: Status Reports on IWRM. http://www.unwater.org/publications/status-report-on-integrated-water-resources-management/en/   
  
  
  
- Data from the 2012 Survey on the Application of Integrated Approaches to Water Resources Management. http://www.unepdhi.org/rioplus20   
  
  
  
- UNEP 2016. Degree of implementation of integrated water resources management. Draft survey to support SDG indicator 6.5.1 http://www.unepdhi.org/whatwedo/gemi .  
  
  
  
Organisation for Economic Co-operation and Development Creditor Reporting System  
  
http://www.oecd.org/dac/stats/data.htm  
  
  
  
Related indicators as of February 2020  
  
  
  
6.5:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
  
  
7.a:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
  
  
13.b:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
  
  
15.9:  
  
Number of deaths, missing persons and persons affected by disaster per 100,000 people [a]  
  
  
  
Comments:  
  
  
  
6.5 (implement integrated water resources management at all levels, including transboundary cooperation as appropriate) 7.a (enhance international cooperation to facilitate access to clean energy research and technology) 13.b (mechanisms for raising capacity for climate change-related planning and management, focusing on women, youth and local and marginalized communities) 15.9 (integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts).

Last updated: 29 September 2017  
  
  
  
  
  
  
  
  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all  
  
Indicator 6.1.1: Proportion of population using safely managed drinking water services  
  
  
  
Institutional information  
  
  
  
Organization(s):  
  
  
  
World Health Organization (WHO)  
  
  
  
United Nations Children's Fund (UNICEF)  
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
  
  
Proportion of population using safely managed drinking water services is currently being measured by the proportion of population using an improved basic drinking water source which is located on premises, available when needed and free of faecal (and priority chemical) contamination. ‘Improved’ drinking water sources include: piped water into dwelling, yard or plot; public taps or standpipes; boreholes or tubewells; protected dug wells; protected springs; packaged water; delivered water and rainwater.  
  
  
  
Rationale:  
  
  
  
MDG target 7C called for ‘sustainable access’ to ‘safe drinking water’. At the start of the MDG period, there was a complete lack of nationally representative data about drinking water safety in developing countries, and such data were not collected through household surveys or censuses. The JMP developed the concept of ‘improved’ water sources, which was used as a proxy for ‘safe water’, as such sources are likely to be protected against faecal contamination, and this metric has been used since 2000 to track progress towards the MDG target. International consultations since 2011 have established consensus on the need to build on and address the shortcomings of this indicator; specifically, to address normative criteria of the human right to water including accessibility, availability and quality.  
  
  
  
The above consultation concluded that JMP should go beyond the basic level of access and address safe management of drinking water services, including dimensions of accessibility, availability and quality. The proposed indicator of ‘safely managed drinking water services’ is designed to address this.  
  
  
  
Concepts:  
  
  
  
Improved drinking water sources include the following: piped water into dwelling, yard or plot; public taps or standpipes; boreholes or tubewells; protected dug wells; protected springs; packaged water; delivered water and rainwater.   
  
  
  
A water source is considered to be ‘located on premises’ if the point of collection is within the dwelling, yard, or plot.  
  
  
  
‘Available when needed’: households are able to access sufficient quantities of water when needed.  
  
  
  
‘Free from faecal and priority chemical contamination’: water complies with relevant national or local standards. In the absence of such standards, reference is made to the WHO Guidelines for Drinking Water Quality (http://www.who.int/water\_sanitation\_health/dwq/guidelines/en/).   
  
E. coli or thermotolerant coliforms are the preferred indicator for microbiological quality, and arsenic and fluoride are the priority chemicals for global reporting.  
  
  
  
Comments and limitations:  
  
  
  
Data on availability and safety of drinking water is increasingly available through a combination of household surveys and administrative sources including regulators, but definitions have yet to be standardized. Data on faecal and chemical contamination, drawn from household surveys and regulatory databases, will not cover all countries immediately. However, sufficient data were available to make global and regional estimates of safely managed drinking water services for four out of eight SDG regions in 2017.  
  
  
  
Methodology  
  
  
  
Computation Method:  
  
  
  
Household surveys and censuses currently provide information on types of basic drinking water sources listed above, and also indicate if sources are on premises. These data sources often have information on the availability of water and increasingly on the quality of water at the household level, through direct testing of drinking water for faecal or chemical contamination. These data will be combined with data on availability and compliance with drinking water quality standards (faecal and chemical) from administrative reporting or regulatory bodies.   
  
  
  
The WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) estimates access to basic services for each country, separately in urban and rural areas, by fitting a regression line to a series of data points from household surveys and censuses. This approach was used to report on use of ‘improved water’ sources for MDG monitoring. The JMP is evaluating the use of alternative statistical estimation methods as more data become available.  
  
  
  
The JMP 2017 update and SDG baselines report describes in more detail how data on availability and quality from different sources, can be combined with data on use of different types of supplies, as recorded in the current JMP database to compute the safely managed drinking water services indicator.   
  
https://washdata.org/report/jmp-2017-report-final.  
  
  
  
Disaggregation:  
  
  
  
Disaggregation by place of residence (urban/rural) and socioeconomic status (wealth, affordability) is possible for all countries. Disaggregation by other stratifiers of inequality (subnational, gender, disadvantaged groups, etc.) will be made where data permit. Drinking water services will be disaggregated by service level (including no services, basic, and safely managed services) following the JMP drinking water ladder.  
  
  
  
Treatment of missing values:  
  
  
  
At country level  
  
The JMP method uses a simple regression model to generate time series estimates for all years including for years without data points. The JMP then shares all its estimates using its country consultation mechanism to get consensus from countries before publishing its estimates.  
  
  
  
At regional and global levels  
  
The JMP does not publish estimates for countries for which national data are not available. Regional and global estimates are made for basic services as long as data are available for 50% of the population with the region, weighting by the latest UN Population Division population estimates. Regional and global estimates for safely managed services used a lower threshold of 30% for the JMP 2017 update and SDG baselines report.  
  
  
  
Regional aggregates:  
  
For more details on JMP rules and methods, please consult the website: www.washdata.org.  
  
  
  
Sources of discrepancies:  
  
  
  
JMP estimates are based on national sources of data approved as official statistics. Differences between global and national figures arise due to differences in indicator definitions and methods used in calculating national coverage estimates. In some cases national estimates are based on the most recent data point rather than from regression on all data points as done by the JMP. In some cases national estimates draw on administrative sector data rather than the nationally representative surveys and censuses used by the JMP.  
  
  
  
Data Sources  
  
  
  
Description:  
  
  
  
Access to water and sanitation are considered core socio-economic and health indicators, and key determinants of child survival, maternal, and children’s health, family wellbeing, and economic productivity. Drinking water and sanitation facilities are also used in constructing wealth quintiles used by many integrated household surveys to analyse inequalities between rich and poor. Access to drinking water and sanitation is therefore a core indicator for most household surveys. Currently the JMP database holds over 1,700 censuses and surveys. In high-income countries where household surveys or censuses do not always collect information on basic access, data are drawn from administrative records.   
  
  
  
Data on availability and quality of drinking water, and regulation by appropriate authorities will be collected by the JMP through consultation with the government departments responsible for drinking water supply and regulation. The JMP routinely conducts country consultations with national authorities before publishing country estimates. Data on availability and quality of water supplies are currently available from household surveys or administrative sources including regulators for over 70 high-income countries, and at least 30-40 low- and middle-income countries. Thus, data are currently available from ca. 100 countries, covering the majority of the global population. This number will rise as regulation becomes more widespread in low- and middle-income countries.  
  
  
  
The population data used by the JMP, including the proportion of the population living in urban and rural areas, are those routinely updated by the UN Population Division.  
  
  
  
Collection process:  
  
  
  
WHO is required by World Health Assembly resolution to consult on all WHO statistics, and seek feedback from countries on data about countries and territories. Before publishing, all JMP estimates undergo rigorous country consultations facilitated by WHO and UNICEF country offices. Often these consultations give rise to in-country visits, and meetings about data on drinking water, sanitation and hygiene services and the monitoring systems that collect these data. JMP has been engaged with more than fifty countries over the last 10 years in explaining JMP estimates, and reasons for discrepancies if any.   
  
  
  
Data Availability  
  
  
  
Description:  
  
  
  
In the JMP 2017 report estimates for basic drinking water services were available for nearly all countries and estimates for safely managed drinking water services were made for 96 countries at national level. Sufficient data were available to estimate safely managed drinking water services at the regional level for the following four SDG regions: Sub-Saharan Africa, Central Asia and Southern Asia, Latin America and the Caribbean, Northern America and Europe.  
  
  
  
Time series:  
  
  
  
Time series data are available for the basic drinking water level of service over the period 2000-2015. These serve as the foundation for the safely managed drinking water service indicator. Some elements of safe management (e.g. water quality) were not collected during the MDG period and trend analysis will only be possible several years into the SDGs. (From 2000 to 2015).  
  
  
  
Calendar  
  
  
  
Data collection:  
  
  
  
The current biennial data collection cycle begins in October during an even year and estimates are published during the following year.   
  
  
  
Data release:  
  
  
  
The baseline SDG report was published in July 2017 and feed into the SG’s 2017 SDG Progress Report. The estimates will be updated in 2019.  
  
  
  
Data providers  
  
  
  
National statistics offices, Ministries of water, sanitation, health, environment. Regulators of water and sanitation services.  
  
  
  
Data compilers  
  
  
  
Name:  
  
  
  
WHO/UNICEF  
  
  
  
Description:  
  
  
  
WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene  
  
  
  
References  
  
  
  
URL:  
  
www.washdata.org  
  
   
  
References:  
  
  
  
JMP website: www.washdata.org.  
  
  
  
JMP 2017 update and SDG baselines  
  
https://washdata.org/report/jmp-2017-report-final  
  
  
  
Safely managed drinking water thematic report  
  
https://washdata.org/report/jmp-2017-tr-smdw  
  
  
  
WHO Guidelines for Drinking Water Quality:  
  
http://www.who.int/water\_sanitation\_health/dwq/guidelines/en/  
  
  
  
  
  
Related indicators as of February 2020  
  
  
  
  
  
All targets under Goal 6, as well as targets 1.2, 1.4, 2.2, 3.2, 3.8, 3.9, 4a, 5.4 and 11.1

Last updated: 09 May 2018  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.  
  
Indicator 6.6.1: Change in the extent of water-related ecosystems  
  
  
  
Institutional information  
  
  
  
Organization(s):  
  
Secretariat of the Ramsar Convention on Wetlands   
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
  
  
Extent of wetlands: this term can be defined as the surface area of wetlands. It is measured in km2 or hectares. It is expected that the surface reported by countries corresponds to the 2017 situation; if not, the reference year should be indicated.   
  
  
  
Change in the extent of wetlands: this term refers to the percentage change in area of wetlands from a baseline reference. For reporting such change, the previous extent, if known, and the period over which the change has taken place should be specified.   
  
  
  
Rationale:  
  
  
  
The Ramsar Convention on Wetlands is the Intergovernmental treaty that provides the framework for the Conservation and wise use of wetlands and their resources. The Convention was adopted in 1971 and came into force in 1975. Since then 170 Countries, representing almost 90% on UN member states, from all the world´s geographic regions have acceded to become Contracting Parties under the Convention.  
  
  
  
At its 52nd meeting, in 2016, the Standing Committee of the Ramsar Convention agreed that Parties would include in their national reports for the 13th meeting of the Conference of the Parties, which have been submitted in January 2018, data on the “extent” of wetlands. This requirement provides an intergovernmental mechanism to obtain verified data that clearly contribute to Indicator 6.6.1 on wetland extent, but also to collect information for Target 15.1 which consider other types of ecosystems.   
  
  
  
The indicator provides a measure of the relative extent of inland wetlands in a country. It follows the rationale of the forest indicator (Indicator 15.1.1). The availability of accurate data on a country's wetland extent based on the country´s wetland inventory is crucial for the decision making regarding policies, restoration of critical wetlands or designation under national or international management or protected area categories.   
  
  
  
Changes in the wetland extent reflect wetland loss and degradation for land use changes or for other uses and may help identify unsustainable practices from different sectors.  
  
  
  
Concepts:  
  
  
  
In order to provide a precise definition of the indicator, it is crucial to provide a definition of   
  
“Water related ecosystems”.  
  
  
  
the Ramsar definition of “wetlands”  
  
  
  
The Ramsar definition is very broad, reflecting the purpose and global coverage of the Convention:  
  
  
  
In accordance with Article 1.1 of the Convention,   
“Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres”.  
  
  
  
In addition, in accordance with Article 2.1, Ramsar Sites   
“may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands”.  
  
  
  
- the Ramsar system of classifying wetland types  
  
  
  
Many national definitions and classifications of “wetlands” are in use. They have been developed in response to different national needs and take into account the main biophysical features (generally vegetation, landform and water regime, and sometimes also water chemistry such as salinity) and the variety and size of wetlands in the locality or region being considered.  
  
  
  
The Ramsar Classification System for Wetland Types, adopted at COP4 in 1990, and amended at COP6 in 1996 (Resolution VI.5) and at COP7 in 1999 (Resolution VII.11) has value as a basic internationally applicable habitat description for sites designated for the Ramsar List of Wetlands of International Importance.  
  
  
  
The System (see Annex 1) describes the types of wetland covered by each of the wetland type codes. Note that the wetland types are grouped in three major categories: marine/coastal, inland, and human-made wetlands. Within a single Ramsar Site or other wetland, there may be wetland types from two or more of these categories, particularly if the wetland is large.   
  
  
  
For the purpose of the Target and Indicator, and based on the National Reports Parties report on the use of the three major categories. Countries also use Ramsar definition that has been internationally agreed under the Convention. The minimum information that should be provided is the total area of wetlands for each of these three categories with an emphasis on inland wetlands or freshwater ecosystems for purpose of indicator 6.6.1 (see table below, the explanations of each wetland type code is in Annex 1).   
  
  
  
Tabulations of Wetland Type characteristics, Inland Wetlands:  
  
Fresh water  
  
Flowing water  
  
Permanent  
  
Rivers, streams, creeks   
  
M  
  
  
  
  
  
  
  
Deltas  
  
L  
  
  
  
  
  
  
  
 Springs, oases  
  
Y  
  
  
  
  
  
Seasonal/intermittent  
  
Rivers, streams, creeks  
  
N  
  
  
  
Lakes and pools  
  
Permanent  
  
> 8 ha  
  
O  
  
  
  
  
  
  
  
< 8 ha  
  
Tp  
  
  
  
  
  
Seasonal/intermittent  
  
> 8 ha  
  
P  
  
  
  
  
  
  
  
< 8 ha  
  
Ts  
  
  
  
Marshes on inorganic soils  
  
Permanent  
  
Herb-dominated  
  
Tp  
  
  
  
  
  
Permanent/ Seasonal/intermittent  
  
Shrub-dominated  
  
W  
  
  
  
  
  
  
  
Tree-dominated  
  
Xf  
  
  
  
  
  
Seasonal/intermittent  
  
Herb-dominated  
  
Ts  
  
  
  
Marshes on peat soils  
  
Permanent  
  
Non-forested  
  
U  
  
  
  
  
  
  
  
Forested  
  
Xp  
  
  
  
Marshes on inorganic or peat soils  
  
High altitude (alpine)  
  
Va  
  
  
  
  
  
Tundra  
  
Vt  
  
Saline, brackish or alkaline water  
  
Lakes  
  
Permanent  
  
Q  
  
  
  
  
  
Seasonal/intermittent  
  
R  
  
  
  
Marshes & pools  
  
Permanent  
  
Sp  
  
  
  
  
  
Seasonal/intermittent  
  
Ss  
  
Fresh, saline, brackish or alkaline water  
  
Geothermal  
  
Zg  
  
  
  
Subterranean  
  
Zk(b)  
  
   
  
  
  
Comments and limitations:  
  
  
  
The 1999 review of the state of wetland inventory worldwide (Global review of wetland resources and priorities for wetland inventory - GRoWI), which was undertaken for the Ramsar Convention, identified not only the major gaps in the extent to which wetland inventory had been undertaken, but also found that for the inventories which had been made it was frequently very hard to trace their existence, to identify their purpose, scope and coverage, and/or to access the information contained in them.   
  
  
  
In the light of these findings and to help address this lack of access by those who need to use wetland inventory for a wide range of Convention implementation purposes, the Convention’s Scientific & Technical Review Panel (STRP) developed a standard model for wetland inventory metadata (i.e., data about the characteristics of a wetland inventory, rather than the inventory data itself) in order to facilitate those who have inventories in making the existence and availability of these more publicly accessible.  
  
  
  
In 2002, several limitations were identified (Ramsar COP8) in the use of EO for routinely deriving wetland information. These included the cost of the technology, the technical capacity needed to use the data, the unsuitability of the data available for some basic applications (in particular in terms of spatial resolution), the lack of clear, robust and efficient user-oriented methods and guidelines for using the technology, and a lack of solid track record of successful case studies that could form a basis for operational activities.   
  
  
  
Historical optical data is available from Landsat and Spot missions; however, persistent cloud cover in certain regions renders much of these data unusable. Distinguishing between permanent and temporary surface water and wetlands can therefore be difficult considering the available historical data. It is further noted that for complex environments with different wetland types in situ data or local knowledge is critical to support the analysis of the EO data, and is sometimes the only way to obtain information on certain wetland types.  
  
  
  
Another limitation is that some countries are in the process of update or complete their national wetlands inventories in others are still gaps or is difficult to access the available information.  
  
  
  
Despite the above limitations, the use of the measure of extent of wetlands will respond to the indicator and will allow to having a practical mechanism in the short term to track the status of water related ecosystems with robust data and foster action for the conservation of these important ecosystems.   
  
  
  
  
  
Methodology  
  
  
  
Computation Method:  
  
Wetland area (Km2 or ha, reference year)/ Change in the extent of wetlands (water-related ecosystems over time) a baseline reference and year.  
  
   
  
Based upon the national wetland inventory (complete or partial) countries provide a baseline figure in square kilometres for the extent of wetlands (according to the Ramsar definition) for the year 2017. The minimum information that should be provided is the total area of wetlands for each of the three major categories; “marine/coastal”, “inland” and “human-made.  
  
  
  
If the information is available countries indicate the % of change in the extent of wetlands over the last three years. If the period of data covers more than three years, countries provide the available information, and indicate the period of the change. For reporting such change, the previous extent, if known, and the period over which the change has taken place should be specified.   
  
  
  
This indicator can be aggregated to global or regional level by adding all country values globally or in a specific region.   
  
  
  
  
  
Disaggregation:  
  
  
  
No further disaggregation of this indicator   
  
  
  
Treatment of missing values:  
  
  
  
At country level  
  
  
  
For countries where no information on wetland inventories was provided to the Ramsar Convention on Wetlands Secretariat as part of their National Reports to COP13 (16% of countries) a report is in preparation by the Ramsar Secretariat using existing information from previous assessments and literature search.  
  
  
  
At regional and global levels  
  
  
  
As indicated above   
  
  
  
Regional aggregates:  
  
  
  
Since information is available for all countries, regional and global estimates are produced by summation.   
  
  
  
Sources of discrepancies:  
  
  
  
The national figures are reported by the countries themselves following standardized format for the National Reports for the COPs that included definitions and reporting years, thus eliminating any discrepancies between global and national figures. The reporting format ensures that countries provide the full reference for original data sources as well as national definitions and terminology.   
  
  
  
Methods and guidance available to countries for the compilation of the data at the national level:  
  
  
  
Countries under the Ramsar Convention provide all data in the form of a country report following a standard format approved by the Standing Committee, which includes the original data and reference of wetland inventories as the main source of information.   
  
  
  
Detailed methodology and guidance on how to provide the data on extent for indicator 6.6.1 in their National Reports and to use Ramsar definition and classification is found in the document “Guidance on information on national wetland extent, to be provided in Target 8 National Wetlands Inventory of the Ramsar National Report for COP13”.   
  
  
  
The Ramsar Convention on Wetlands has taken many steps to ensure the wise use and conservation of wetlands globally. This has included the development and promotion of guidance and best practice tools for the inventory, assessment and monitoring of change in wetlands with a particular emphasis in recent years on the application of an increasing number of satellite-based remote sensing approaches (Davidson & Finlayson 2007; Mackay et al. 2009; Ramsar Secretariat 2010a). This has become necessary as there is an increasing demand for information that can be readily used by wetland managers to help stem the ongoing loss and degradation of wetlands.   
  
  
  
The utility of different remote sensing datasets for wetland inventory, monitoring and assessment is well established, in particular through the provision of site based (Land Use Land Cover (LULC)) maps characterising a particular ecosystem, to the analysis of time series data (remote sensing datasets collected consistently over a particular time period) to determine changes.  
  
  
  
The availability and accessibility of EO datasets suitable for addressing the information needs of the Ramsar Convention and wetland practitioners has increased dramatically in the recent past; increasing capabilities in terms of spatial, temporal and spectral resolution of the data have enabled more efficient and reliable monitoring of the environment over time at global, regional and local scales.  
  
  
  
The Scientific and Technical Review Panel of the Convention is working in a Ramsar Technical Report on “Best practice guidelines for the use of Earth Observation for wetland inventory, assessment and monitoring: An information source for wetland managers provided by the Ramsar Convention for Wetlands”. The Ramsar Convention and EO based approaches build on those previously undertaken on the use of EO technologies for implementation of the Convention (Ramsar 2002; Davidson & Finlayson 2007; Mackay et al. 2009) and are placed within the conceptualisation of wetland inventory, assessment and monitoring that were incorporated into the IF-WIAM (Ramsar Secretariat 2010b).   
  
  
  
The purpose of the report is to provide an overview of the application of EO technologies to inform wetland managers and practitioners, and stakeholders, including those from related sectors, such as protected area managers and wetland education centre staff (Ramsar Convention 2015) about “best practice” use of EO technologies, taking into account requirements and recommendations from the Convention.   
  
  
  
EO provides an effective means for periodic mapping and monitoring over regional to global scales. It should, however, not be expected that global datasets, can achieve the same high level of accuracy everywhere as a local scale map derived through ground surveys and the use of finer resolution (aerial, drones) geospatial data.  
  
  
  
Although mapping of land cover and land uses are one of the most common uses of EO data, there are still challenges in assessing the current status and changes in wetlands over time. Monitoring historical trends and changing patterns of wetlands is complicated by the lack of medium to high-resolution data in particular prior to 2000.   
  
  
  
Despite the ever expanding data archives, improving quality and increasing suitability of EO data for wetland inventory, monitoring and assessment, it is important to note that “ground-truthing” or field based assessments and validation are still a vital component of any work involving EO data, whose occasional omission may still lead to problematic results.   
  
  
  
Ramsar partners such as Jaxa and ESA have conducted pilot projects that provide geospatial information to provide changes to Ramsar, national wetland practitioners, decision makers, and NGOs.   
  
  
  
Wetland inventory provides the basis for guiding the development of appropriate assessment and monitoring, and is used to collect information to describe the ecological character of wetlands including that used to support the listing of Ramsar sites, as recorded in the Ramsar Information Sheet (Ramsar Secretariat 2012), assessment considers the pressures and associated risks of adverse change in ecological character; and monitoring, which can include both survey and surveillance, provides information on the extent of any change that occurs as a consequence of management actions.   
  
  
  
Under the Convention multiple guidelines have been developed to support countries to complete national wetland inventories including the use of metadata (Some of these guidelines are mentioned below).   
  
  
  
Ramsar Guidelines  
  
   
  
Ramsar Handbooks: Handbook 13 Inventory, assessment and monitoring, and Handbook 15 Wetland Inventory http://www.ramsar.org/resources/ramsar-handbooks.  
  
  
  
Ramsar Technical Report Low-cost GIS software and data for wetland inventory, assessment & monitoring.   
  
https://www.ramsar.org/sites/default/files/documents/pdf/lib/lib\_rtr02.pdf  
  
  
  
Ramsar Technical Report 4: A Framework for a wetland inventory metadatabase.  
  
https://www.ramsar.org/sites/default/files/documents/pdf/lib/lib\_rtr04.pdf  
  
  
  
Ramsar 2002. The Ramsar Convention on Wetlands, The 8th Meeting of the Conference of the Parties to the Convention on Wetlands, Valencia, Spain, 18-26 November 2002, COP8 DOC. 35, The use of Earth Observation technology to support the implementation of the Ramsar Convention, http://www.ramsar.org/sites/default/files/documents/pdf/cop8/cop8\_doc\_35\_e.pdf  
  
  
  
Resolution VIII.6 A Ramsar Framework for Wetland Inventory http://www.ramsar.org/document/resolution-viii6-a-ramsar-framework-for-wetland-inventory  
  
  
  
Resolution VI.12 National Wetland Inventories and candidate sites for listing http://www.ramsar.org/sites/default/files/documents/pdf/res/key\_res\_vi.12e.pdf  
  
  
  
Resolution VII.20 Priorities for wetland inventory http://www.ramsar.org/sites/default/files/documents/library/key\_res\_vii.20e.pdf  
  
  
  
Resolution IX.1 Additional scientific and technical guidance for implementing the Ramsar wise use concept Annex E. An Integrated Framework for wetland inventory assessment and monitoring http://www.ramsar.org/sites/default/files/documents/pdf/res/key\_res\_ix\_01\_annexe\_e.pdf  
  
  
  
Resolution X.15 Describing the ecological character of wetlands and data needs and formats for core inventory: harmonized scientific and technical guidance http://www.ramsar.org/sites/default/files/documents/pdf/res/key\_res\_x\_15\_e.pdf  
  
  
  
  
  
Quality assurance  
  
  
  
Once received, the country reports undergo a rigorous review process to ensure correct use of definitions and methodology as well as internal consistency. A comparison is made with past information and other existing data sources. Regular contacts between national correspondents and Ramsar Staff by e-mail and webinars/regional/sub-regional review workshops form part of this review process in order to support country capacities in particular for monitoring purposes.   
  
  
  
Missing reports prepared by the Ramsar Secretariat for Indictor 6.6.1 are sent to the respective Ramsar Administrative Authority for validation before finalization and publishing of data. The data are then aggregated at sub-regional, regional and global levels by the Ramsar Secretariat team.   
  
  
  
  
  
Data Sources  
  
  
  
Description:  
  
  
  
The Ramsar Convention on Wetlands Secretariat has been collecting and analysing data on country implementation since 2000 including information about wetland inventories. This is done at intervals of 3 years that is the cycle of Country reporting under the Convention   
  
  
  
The 1999 review of the state of wetland inventory worldwide (Global review of wetland resources and priorities for wetland inventory - GRoWI), which was undertaken for the Ramsar Convention, identified not only the major gaps in the extent to which wetland inventory had been undertaken, but also found that for the inventories which had been made it was frequently very hard to trace their existence, to identify their purpose, scope and coverage, and/or to access the information contained in them.  
  
  
  
Another source of information is the update of the Wetland Extent Trends (WET) Index that was commissioned by the Ramsar Convention Secretariat to WCMC. The Wet Index is an updatable indicator of wetland area trends where there are still gaps of information. However, is not applicable at national level and has been used, as data are not available at national level. This will be fixed with national reports.   
  
  
  
In the format for National Report for COP13 the Contracting Parties agreed the inclusion of an indicator on the extent of wetlands and change in the extent (indicator 6.6.1). For COP13, 44% of Contracting Parties have completed national wetlands inventories and 16% of Parties reported that their wetland inventories are in progress. Therefore, all data are provided to the Ramsar Secretariat by countries in the form of a country report following a standard format, which includes the original data and reference sources and descriptions of how these have been used to estimate the extent of wetlands.   
  
  
  
Collection process:  
  
  
  
All data are provided by Ramsar Administrative Authorities to the Ramsar Secretariat in the form of country reports of implementation of the Convention based on a standard format that it is been approved by the Standing Committee. The format includes indicators to estimate wetland extent with reference sources.  
  
  
  
As indicated in the Quality Assurance section, for remaining countries where no information is provided, a report is prepared by the Ramsar Secretariat using existing information and a literature search. All country reports (including those prepared by the Ramsar Secretariat) are sent to the respective Administrative Authority for validation before finalization.  
  
  
  
Data Availability  
  
  
  
Description:  
  
  
  
Data are available for all countries (143) that submitted National Reports for COP13 as well as for previous COPs as indicated below. The data collected include information on wetland inventories and extent. For the missing country data (16%) as indicated in the “Quality assurance section” the Secretariat will prepare in 2018 reports with the available source of information for Indictor 6.6.1 that will be sent to the respective Ramsar Administrative Authorities for validation. The gaps of information will be addressed during 2018 and 2019 to fully report in late 2020.   
  
  
  
Time series:  
  
  
  
The Secretariat holds National Report information from COP8 (2002), COP9 (2005), COP10 (2008), COP11 (2012), COP12 (2015) and COP13 (2018) National Reports, in databases which permit an analysis of trends in implementation over time, from the 2002-2005 triennium to 2012-2015 that includes specific indicators such as wetland inventories. However, for wetland extent the data collection has started in 2018.   
  
  
  
Calendar  
  
  
  
Data collection:  
  
  
  
Data collection process for indicator 6.6.1 has started in 2018 and data collection will take place also in 2019.   
  
   
  
Data release:  
  
  
  
Updated data with time series and including year 2020 will be released late 2020.   
  
  
  
Data providers  
  
  
  
Ramsar Administrative Authorities prepare and submit to the Ramsar Secretariat their National Reports on implementation for each Conference of the Parties. Countries with dependent territories prepare more than one report. For the remaining countries where no information is provided, a report is prepared by the Ramsar Secretariat using existing information and a literature search that is validated by the concern countries.   
  
  
  
  
  
Data compilers  
  
  
  
Secretariat of the Ramsar Convention on Wetlands: The Secretariat expect to work with UNEP as co-custodian of this indicator and other UN agencies and partners.   
  
  
  
References  
  
  
  
References and links are provide in the section of methods and guidance available to countries for the compilation of the data at the national level.  
  
  
  
Related indicators as of February 2020  
  
Linkages with any other Goals and Targets: 15.1.  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
Annex 1 Ramsar Wetland Classification  
  
  
  
The codes are based upon the Ramsar Classification System for Wetland Types, as approved by the Conference of the Contracting Parties in Recommendation 4.7 and amended by Resolutions VI.5 and VII.11.   
  
  
  
To assist in identification of the correct Wetland Types, the Secretariat has provided below tabulations of some of the characteristics of each Wetland Type, for Marine/Coastal Wetlands and Inland Wetlands.   
  
  
  
 Marine/Coastal Wetlands  
  
   
  
 A -- Permanent shallow marine waters in most cases less than six metres deep at low tide; includes sea bays and straits.  
  
 B -- Marine subtidal aquatic beds; includes kelp beds, sea-grass beds, tropical marine meadows.  
  
 C -- Coral reefs.  
  
 D -- Rocky marine shores; includes rocky offshore islands, sea cliffs.  
  
 E -- Sand, shingle or pebble shores; includes sand bars, spits and sandy islets; includes dune systems and humid dune slacks.  
  
 F -- Estuarine waters; permanent water of estuaries and estuarine systems of deltas.  
  
 G -- Intertidal mud, sand or salt flats.  
  
 H -- Intertidal marshes; includes salt marshes, salt meadows, saltings, raised salt marshes; includes tidal brackish and freshwater marshes.  
  
 I -- Intertidal forested wetlands; includes mangrove swamps, nipah swamps and tidal freshwater swamp forests.   
  
 J -- Coastal brackish/saline lagoons; brackish to saline lagoons with at least one relatively narrow connection to the sea.  
  
 K -- Coastal freshwater lagoons; includes freshwater delta lagoons.  
  
 Zk(a) – Karst and other subterranean hydrological systems, marine/coastal  
  
  
  
Tabulations of Wetland Type characteristics, Marine / Coastal Wetlands:  
  
Saline water  
  
Permanent  
  
< 6 m deep  
  
A  
  
  
  
  
  
Underwater vegetation  
  
B  
  
  
  
  
  
Coral reefs  
  
C  
  
  
  
Shores  
  
Rocky  
  
D  
  
  
  
  
  
Sand, shingle or pebble  
  
E  
  
Saline or brackish water  
  
Intertidal  
  
Flats (mud, sand or salt)  
  
G  
  
  
  
  
  
Marshes  
  
H  
  
  
  
  
  
Forested  
  
I  
  
  
  
Lagoons  
  
J  
  
  
  
Estuarine waters  
  
F  
  
Saline, brackish or fresh water  
  
Subterranean  
  
Zk(a)  
  
Fresh water  
  
Lagoons  
  
K  
  
   
  
  
  
  
 Inland Wetlands  
  
   
  
 L -- Permanent inland deltas.  
  
 M -- Permanent rivers/streams/creeks; includes waterfalls.  
  
 N -- Seasonal/intermittent/irregular rivers/streams/creeks.  
  
 O -- Permanent freshwater lakes (over 8 ha); includes large oxbow lakes.  
  
 P -- Seasonal/intermittent freshwater lakes (over 8 ha); includes floodplain lakes.  
  
 Q -- Permanent saline/brackish/alkaline lakes.  
  
 R -- Seasonal/intermittent saline/brackish/alkaline lakes and flats.  
  
 Sp -- Permanent saline/brackish/alkaline marshes/pools.  
  
 Ss -- Seasonal/intermittent saline/brackish/alkaline marshes/pools.   
  
 Tp -- Permanent freshwater marshes/pools; ponds (below 8 ha), marshes and swamps on inorganic soils; with emergent vegetation water-logged for at least most of the growing season.  
  
 Ts -- Seasonal/intermittent freshwater marshes/pools on inorganic soils; includes sloughs, potholes, seasonally flooded meadows, sedge marshes.  
  
 U -- Non-forested peatlands; includes shrub or open bogs, swamps, fens.  
  
 Va -- Alpine wetlands; includes alpine meadows, temporary waters from snowmelt.  
  
 Vt -- Tundra wetlands; includes tundra pools, temporary waters from snowmelt.  
  
 W -- Shrub-dominated wetlands; includes shrub swamps, shrub-dominated freshwater marshes, shrub carr, alder thicket on inorganic soils.  
  
 Xf -- Freshwater, tree-dominated wetlands; includes freshwater swamp forests, seasonally flooded forests, wooded swamps on inorganic soils.  
  
 Xp -- Forested peatlands; peatswamp forests.  
  
 Y -- Freshwater springs; oases.   
  
 Zg -- Geothermal wetlands.  
  
 Zk(b) – Karst and other subterranean hydrological systems, inland.  
  
   
  
 Note: “floodplain” is a broad term used to refer to one or more wetland types, which may include examples from the R, Ss, Ts, W, Xf, Xp, or other wetland types. Some examples of floodplain wetlands are seasonally inundated grassland (including natural wet meadows), shrublands, woodlands and forests. Floodplain wetlands are not listed as a specific wetland type herein.  
  
  
  
Tabulations of Wetland Type characteristics, Inland Wetlands:  
  
Fresh water  
  
Flowing water  
  
Permanent  
  
Rivers, streams, creeks   
  
M  
  
  
  
  
  
  
  
Deltas  
  
L  
  
  
  
  
  
  
  
Springs, oases  
  
Y  
  
  
  
  
  
Seasonal/intermittent  
  
Rivers, streams, creeks  
  
N  
  
  
  
Lakes and pools  
  
Permanent  
  
> 8 ha  
  
O  
  
  
  
  
  
  
  
< 8 ha  
  
Tp  
  
  
  
  
  
Seasonal/intermittent  
  
> 8 ha  
  
P  
  
  
  
  
  
  
  
< 8 ha  
  
Ts  
  
  
  
Marshes on inorganic soils  
  
Permanent  
  
Herb-dominated  
  
Tp  
  
  
  
  
  
Permanent/ Seasonal/intermittent  
  
Shrub-dominated  
  
W  
  
  
  
  
  
  
  
Tree-dominated  
  
Xf  
  
  
  
  
  
Seasonal/intermittent  
  
Herb-dominated  
  
Ts  
  
  
  
Marshes on peat soils  
  
Permanent  
  
Non-forested  
  
U  
  
  
  
  
  
  
  
Forested  
  
Xp  
  
  
  
Marshes on inorganic or peat soils  
  
High altitude (alpine)  
  
Va  
  
  
  
  
  
Tundra  
  
Vt  
  
Saline, brackish or alkaline water  
  
Lakes  
  
Permanent  
  
Q  
  
  
  
  
  
Seasonal/intermittent  
  
R  
  
  
  
Marshes & pools  
  
Permanent  
  
Sp  
  
  
  
  
  
Seasonal/intermittent  
  
Ss  
  
Fresh, saline, brackish or alkaline water  
  
Geothermal  
  
Zg  
  
  
  
Subterranean  
  
Zk(b)  
  
   
  
   
  
 Human-made wetlands  
  
   
  
 1 -- Aquaculture (e.g. fish/shrimp) ponds.  
  
 2 -- Ponds; includes farm ponds, stock ponds, small tanks (generally below 8 ha).  
  
 3 -- Irrigated land; includes irrigation channels and rice fields.  
  
 4 -- Seasonally flooded agricultural land (including intensively managed or grazed wet meadow or pasture).  
  
 5 -- Salt exploitation sites; salt pans, salines, etc.  
  
 6 -- Water storage areas; reservoirs/barrages/dams/impoundments (generally over 8 ha).  
  
 7 -- Excavations; gravel/brick/clay pits; borrow pits, mining pools.  
  
 8 -- Wastewater treatment areas; sewage farms, settling ponds, oxidation basins, etc.  
  
 9 --Canals and drainage channels, ditches.  
  
Zk(c) – Karst and other subterranean hydrological systems, human-made

Last updated: 09 May 2018  
  
  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.6: By 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes  
  
Indicator 6.6.1: Change in the extent of water-related ecosystems over time  
  
  
  
Institutional information  
  
  
  
Organization(s):  
  
UN Environment (United Nations Environment Programme)  
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
The indicator includes five categories: 1) vegetated wetlands, 2) rivers and estuaries, 3) lakes, 4) aquifers, and 5) artificial waterbodies. For purposes of this methodology, the text refers only to these five ecosystem category terminologies. To address its complexity, Indicator 6.6.1 has been divided into 5 Sub-Indicators to capture the various data sources and methodologies required for monitoring components of the Indicator. Data sources come from a combination of ground sampling and earth observations. Depending on the type of ecosystem and the type of extent being measured, the data collection methodology can also differ greatly. A progressive monitoring approach with two levels is proposed:  
  
  
  
Level 1: 2 Sub-Indicators based on globally available data from earth observations which will be validated by countries against their own methodologies and datasets:   
  
• Sub-Indicator 1 – spatial extent of water-related ecosystems   
  
• Sub-Indicator 2 – water quality of lakes and artificial water bodies  
  
Level 2: Data collected by countries through 3 Sub-Indicators:  
  
• Sub-Indicator 3 – quantity of water (discharge) in rivers and estuaries  
  
• Sub-Indicator 4 – water quality imported from SDG Indicator 6.3.2   
  
• Sub-Indicator 5 – quantity of groundwater within aquifers  
  
  
  
A full methodology for this indicator is available in the document entitled, “Monitoring Methodology for SDG Indicator 6.6.1”.  
  
  
  
Rationale:  
  
  
  
Target 6.6 aims to “protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes” through Indicator 6.6.1 which aims to understand how and why these ecosystems are changing in extent over time. All of the different components of Indicator 6.6.1 are important to form a comprehensive picture that enables informed decisions towards the protection and restoration of water-related ecosystems. However, a lack of data within countries to support Indicator 6.6.1 has become clear through the 2017 pilot testing and thus a combination of national data and data based on satellite images is proposed. All data generated is processed using internationally recognized methodologies, resulting in high quality global datasets with extensive spatial and temporal scale.  
  
  
  
Concepts:  
  
The concepts and definitions used in the methodology have been based on existing international frameworks and glossaries unless where indicated otherwise below.  
  
Water-related ecosystems – includes five categories: 1) vegetated wetlands, 2) rivers and estuaries, 3) lakes, 4) aquifers, and 5) artificial waterbodies. For purposes of this methodology, the text refers only to these five ecosystem category terminologies. The majority of water-related ecosystem types monitored in Indicator 6.6.1 contain freshwater, with the exception of mangroves and estuaries which contain brackish waters and are included in Indicator 6.6.1. Ecosystems containing or within salt waters are not included as these are covered within other SDG indicators (Goal 14). Other categories of wetlands aligning with the Ramsar Convention definitions are captured within the ecosystem category of ‘vegetated wetlands’.   
  
Vegetated Wetlands – the water-related ecosystem category of vegetated wetlands includes swamps, fens, peatlands, marshes, paddies, and mangroves. This definition is closely related to the Ramsar Convention on Wetlands definition of wetlands, which is: “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres” with the exception that salt waters are not included in Indicator 6.6.1 reporting (as they are covered in SDG 14) and with the exception that vegetated wetlands are distinct from the other ecosystem categories of lakes, rivers and estuaries, aquifers, and artificial waterbodies. Vegetated wetlands have been separated as their own ecosystem category because of their importance for target achievement and because the methodology for monitoring them with earth observations is unique from other open waters. The data generated by applying this methodology will also generate data required by countries to report to the Ramsar Convention on Wetlands.  
  
Artificial Waterbodies – the water-related ecosystem category of artificial waterbodies includes open waterbodies created by humans such as reservoirs, canals, harbors, mines and quarries. While it is recognized that these are not traditional water ecosystems which should be protected and restored, in some countries they hold a noteworthy amount of freshwater and have thus been included.  
  
Open Water – as any area of surface water unobstructed by aquatic vegetation. This includes the following 3 water-related ecosystem categories: rivers and estuaries, lakes, and artificial waterbodies.  
  
Extent – has been expanded beyond spatial extent to capture additional basic parameters needed for the protection and restoration of water-related ecosystems. Extent includes three components: the spatial extent or surface area, the quality, and the quantity of water-related ecosystems.   
  
Change – a shift from one condition of extent to another over time within a water-related ecosystem, measured against a point of reference.  
  
Comments and limitations:  
  
  
  
This methodology mobilizes the collection of widely available earth observation data on spatial extent and some water quality parameters which will be validated by countries. The data itself in the form of images and numbers is straightforward to understand. However, the methodologies used to generate this data are technical in nature and some countries may wish understand these better. The methodology employs internationally recognized methods, from expert communities such as the Group on Earth Observation (GEO) and international space agencies, to derive statistically sound and the most technologically advanced earth observation datasets for Sub-Indicators 1 and 2. These organizations will also be engaged to provided tools and training to support countries. Sub-Indicator 2 only measures two water quality parameters, while it is recognized that to determine good water quality requires measuring multiple parameters. However, globally available data can indicate potential hot spots of pollution or human disturbance allowing countries to undertake more local assessments of water quality.  
  
  
  
The Indicator is designed in a way to generate data to allow informed decision making towards protecting and restoring water-related ecosystems. It does not measure how many water-related ecosystems have been protected and restored. It is assumed that countries would use the data to actively make decisions, but these actions are not currently being measured. The data generated should be considered alongside other data such as land use change to enable decision-makers to protect and restore water-related ecosystems.  
  
  
  
Methodology  
  
  
  
Computation Method:  
  
  
  
The 5 Sub-Indicators are computed separately and thus Indicator 6.6.1 is comprised of 5 stand-alone methodologies.   
  
Sub-Indicator 1: Spatial Extent of Water-related Ecosystems  
  
The methodology for this Sub-Indicator describes how Earth observations are generated and processed into a global spatial extent of water-related ecosystems dataset. The basic premise of this approach is that different land covers, such as snow, bare rock, vegetation, and water, reflect different wavelengths of light. Satellites continually circulate our earth, capturing images and wavelengths reflected from every location on the globe. For any one location on earth, thousands of images can be combined to classify the site’s land cover. Advanced computing technology can be programmed to digest all of these images and split the earth into land cover type pixels, one of which is open water. Open water is defined as any area of surface water unobstructed by aquatic vegetation. Thus, changes in the spatial extent of open water locations over a long period of time can be discerned including new and lost waterbodies or seasonal changes.   
  
To distinguish one water-related ecosystem type from another, further processing of this open water data is required in conjunction with other datasets. The data generated on open water is further distinguished into lakes, rivers and estuaries versus artificial waterbodies. In addition, vegetated wetlands are discerned through further processing. The method to detect vegetated wetlands from Earth observations is based on an approach which detects the physical properties of wetland areas (e.g. soil moisture and vegetation water content) from multi-temporal SAR (Synthetic Aperture Radar) and optical satellite imagery, combined with other geospatial datasets related to the topography of the area, the hydrography of the watershed and its drainage network, and the soil types. The resulting datasets obtained from earth observations on the spatial extent of vegetated wetlands and artificial waterbodies are excluded from the calculation of spatial extent values for lakes, rivers and estuaries, to prevent duplication of spatial extent estimations.   
  
Thus, three global datasets are generated through this methodology annually: spatial extent of lakes, rivers, and estuaries; spatial extent of artificial waterbodies; and spatial extent of vegetated wetlands. These national spatial extent datasets are provided to countries to validate. Once validated, the annual datasets are used to calculate percentage change of spatial extent over time, using a 2001-2005 baseline period. Subsequent five year averages are compared to this baseline.   
  
Where = the average national spatial extent from 2001-2005   
  
Where = the average national spatial extent of any other 5 year period  
  
  
  
  
  
  
  
Sub-Indicator 2: Water Quality of Lakes and artificial water bodies  
  
The methodology for this Sub-Indicator describes how Earth observations are generated and processed into two datasets of chlorophyll a (Chl) and total suspended solids (TSS) within lakes globally. Earth observations can only provide information on concentrations of in-water materials that affect the colour of water. These materials include Chl, which is the primary pigment in phytoplankton (the primary source of food on the food-chain), and TSS. The concentrations of Chl and TSS can be used as proxies to infer other important waterbody characteristics.  
  
Chl and TSS results are derived using empirical algorithms, generated for each individual pixel to ensure the spatial variability within each lake is fully captured. Results are averaged over a year for each lake to produce lake-wide Chl and TSS concentrations and small localized fluctuations in concentration of these two parameters are not shown. On any one day, the pixels representing each concentration of Chl or TSS are quantified and a lake-wide average is determined for that day.   
  
The change in concentration of both Chl and TSS can be determined from comparing an annual average against the baseline. This annual average Chl and TSS will be averaged every 5 years, which will be compared to the Chl and TSS baselines to generate a percentage change. The locations where percentage change is excessive can be targeted for increased water quality monitoring and management.   
  
Sub-Indicator 3: Quantity (Discharge) of Water in Rivers and Estuaries  
  
The methodology for this Sub-Indicator describes different techniques for countries to implement to monitor river and estuary discharge. These techniques can include gauging stations or discharge meters. The methodology does not prescribe the type of discharge measurement technique because selection should be based on the size and type of the waterbody, terrain and velocity of water flow, the desired accuracy of measurement, as well as finances available. However, any discharge data collected by countries must adhere to the following minimum criteria:  
  
Discharge data from each river/estuary monitored should be collected at least once per month. This data should then be averaged to obtain an annual average discharge per river/estuary monitored.   
  
Each basin should have at minimum of one sampling location, at the point where its water exits into another basin or crosses a national boundary.   
  
Countries will submit 5 years of data on annual average discharges per basin to the custodian agencies. The data from these 5 years will be averaged to smooth short-term variability. To generate national percentage change of discharge over time, a common reference period for all basins must be established. This baseline period will be used to calculate percentage change of discharge for any subsequent 5-year period. To calculate percentage change in discharge for each five year period following the reference period, the following formula is used:  
  
Where = historical 5 year reference discharge   
  
Where = the average discharge of 5 year period of interest  
  
  
  
  
  
Sub-Indicator 4: Quality of Water-related Ecosystems  
  
The methodology for this Sub-Indicator is described in SDG Indicator 6.3.2. The data collected for Indicator 6.3.2 is utilized for Sub-Indicator 4 to inform a calculation of percentage change over time in waterbodies with good ambient water quality.   
  
Sub-Indicator 5: Quantity of Groundwater within Aquifers  
  
The methodology for this Sub-Indicator describes a simplified technique for countries to monitor groundwater quantity within aquifers. The volume of groundwater stored in an aquifer is most traditionally estimated using a combination of parameters but for the purposes of Indicator 6.6.1 monitoring, the ‘head’ or level of groundwater within an aquifer can solely be measured as a proxy for groundwater volume within an aquifer. Measuring the level of groundwater within an aquifer is done through the use of boreholes. The methodology does not prescribe the number of boreholes to be monitored per aquifer because the distribution of groundwater can be variable depending on the location and characteristics of aquifers. However, any groundwater level data collected by countries must adhere to the following minimum criteria:  
  
Point measurements of groundwater level within aquifers should be collected at least twice per year. This data should then be averaged to obtain an annual average groundwater level per aquifer monitored. Understanding the seasonal and other short term changes is a necessary aspect of management of groundwater but should only be considered as part of the local management of the groundwater.  
  
Each aquifer monitored should have at minimum one borehole that can be used for groundwater level measurements.  
  
Countries will submit 5 years of data on annual average groundwater level per basin to the custodian agencies, which will be averaged to smooth short-term variability. To generate national percentage change of discharge over time, a common reference period for all basins must be established. This baseline period will be used to calculate percentage change of groundwater quantity for any subsequent 5-year period. To calculate percentage change in quantity for each five year period following the reference period, the following formula is used:  
  
  
  
Where = historical 5 year reference groundwater level   
  
Where = the average groundwater level of 5 year period of interest  
  
  
  
  
  
  
  
Disaggregation:  
  
Indicator 6.6.1 can be disaggregated by each Sub-Indicator. All Sub-Indicators can also be disaggregated at different spatial scales i.e.. National, basin, and ecosystem type.  
  
  
  
Treatment of missing values:  
  
At country level  
  
Due to the use of satellite data for some sub-indicators, it is not expected to have missing data for these sub-indicators. For all other sub-indicators, missing values are not imputed.   
  
  
  
At regional and global levels  
  
Missing values are not imputed.  
  
  
  
Regional aggregates:  
  
For the aggregation methods, please see:   
  
http://pre-uneplive.unep.org/media/docs/graphs/aggregation\_methods.pdf.   
  
  
  
Sources of discrepancies:  
  
NA  
  
  
  
Data Sources  
  
Description:  
  
Sub-Indicator 1: Open water spatial extent data, acquired by the Landsat 5, 7 and 8 satellites at a 30 m resolution, has been generated for the entire globe from 2001-2015. From 2016 onwards (up to and including 2030), higher spatial and temporal resolution satellites, including both optical and radar satellites, will be used. For example, 20 m Sentinel 1 (radar) and 10 m Sentinel 2 (optical) satellites, used in combination with Landsat satellites, will allow for a more precise delineation of water bodies both in spatial terms (due to the higher spatial resolution) and in temporal terms (due to the higher revisit time). Additional datasets will be used refine open water spatial extent data, including the Global Reservoir and Dam (GRanD) geospatial database. To generate spatial extent of vegetated wetlands, a combination of imagery from Landsat 8 and Sentinel 1 and 2 will be used. This will be augmented by other existing global datasets such as the Global Mangrove Watch (GMW) annual mangrove maps, as well as the most locally-adapted geospatial datasets capturing topography, hydrography, drainage networks, and soil types.   
  
  
  
Sub-Indicator 2: Chl and TSS lake observations are obtained from combined Landsat and Sentinel satellites paired with instruments like OLCI, MODIS, and VIIRS. The sensor instruments used to detect TSS and Chl determine the spatial resolution of water quality within lakes which can be detected. Some of the more accurate water quality sensors have 250-350 meter resolution, while less accurate sensors can detect TSS and Chl changes to 100 m resolution.   
  
  
  
Sub-Indicator 3: The source of data for monitoring discharge for this Sub-Indicator is primarily from ground in situ measurements within rivers and estuaries, though modelled data is also acceptable.   
  
  
  
Sub-Indicator 4: The source of data for monitoring water quality for this Sub-Indicator is from ground in situ measurements within water-related ecosystems.   
  
  
  
Sub-Indicator 5: The source of data for monitoring groundwater quantity for this Sub-Indicator is from ground in situ measurements of groundwater level within aquifers, though modelled data is also acceptable.   
  
  
  
Collection process:  
  
Sub-Indicators 1 and 2: All globally available data generated for Sub-Indicators 1 and 2 is shared with countries for validation. This geospatial data will be generated annually at national, sub-national, and waterbody scales. While this data is generated annually, the measurement to report change in extent requires validation every five years. Validated annual datasets will be utilized by the custodian agencies to generate percentage changes on behalf of countries.   
  
  
  
Sub-Indicators 3, 4, and 5: All data collected within countries for Sub-Indicators 3, 4, and 5 will be submitted to the custodian agencies for review and quality assurance checks against the methodology minimum criteria. This review process will be facilitated via email communication through the global help desk. Once annual ‘raw’ data is reviewed, percentage change calculations will be completed and validated between the custodian agencies and the national representative.   
  
  
  
Data Availability  
  
  
  
Description:  
  
The data for Sub-Indicators 1 and 2 is available annually. For Sub-Indicators 3, 4, and 5, data is already available from some countries and national authorities should strengthen their monitoring and report efforts to expand data availability for these three sub-indicators.  
  
  
  
Data collection for all Sub-Indicators was included in a 2017 data drive to countries; however, the data is still being validated. In addition, national spatial extent data for 188 countries has been collected from 2001-2015 to support Sub-Indicator 1. Data for all 5 Sub-Indicators is reported to UNSD every 5 years.  
  
  
  
Time series:  
  
The reporting on this indicator will follow an annual cycle.   
  
  
  
Calendar  
  
  
  
Data collection:  
  
 Annual estimation of sub-indicators 1 and 2 released around May. Every five years data will be collected through a national data drive as follows: 2017, 2022, 2027.  
  
   
  
Data release:  
  
First reporting cycle: June 2018; Second reporting cycle: June 2023; Third reporting cycle: June 2028.  
  
  
  
Data providers  
  
GEMS/Water National Focal Points, in consultation with NSOs  
  
Satellite data from ESA and NASA  
  
  
  
Data compilers  
  
 UN Environment (United Nations Environment Programme)   
  
  
  
References  
  
  
  
URL: http://www.sdg6monitoring.org/indicators/target-66/indicators661/  
  
  
  
Related indicators as of February 2020  
  
  
  
6.3.2, 6.4.1, 6.4.2, 6.5.1, 6.5.2, 15.3.1  
  
  
  
Additional information  
  
  
  
The methodology was tested in two pilot phases. The first of these involved designing the methodology in consultation with countries resulting in a first draft of the methodology which was reviewed and strengthened by the Target Team. In early 2016, the draft methodology was pilot tested in five countries between April and November 2016 through workshops: Jordan, the Netherlands, Peru, Senegal, and Uganda. In each of these countries, various participants from national entities and government sectors were engaged to obtain wide feedback on the technical feasibility of the draft methodology.   
  
During the 2016 country pilots of the draft methodology, the NSO from each of the 5 countries was consulted and engaged in the process. During the 2017 pilot methodology data drive, the initial request for data was communicated to all NSOs. In addition, in October 2017 national data on spatial extent of open water (derived from earth observations) was shared with 188 countries, directly via their NSOs (see further details above).

Last updated: 13 March 2019  
  
  
  
  
  
  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity  
  
Indicator 6.4.1: Change in water-use efficiency over time  
  
  
  
Institutional information  
  
  
  
Organization(s):  
  
Food and Agriculture Organization of the United Nations (FAO)  
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
The change in water use efficiency over time (CWUE). The change in the ratio of the value added to the volume of water use, over time.  
  
  
  
Water Use Efficiency (WUE) is defined as the value added of a given major sector divided by the volume of water used. Following ISIC 4 coding, sectors are defined as:  
  
agriculture; forestry; fishing (ISIC A), hereinafter “agriculture”;  
  
mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; constructions (ISIC B, C, D and F), hereinafter “MIMEC”;  
  
all the service sectors (ISIC E and ISIC G-T), hereinafter “services”.  
  
  
  
The unit of the indicator is expressed in Value/Volume, commonly USD/m3.  
  
  
  
Rationale:  
  
The rationale behind this indicator consists in providing information on the efficiency of the economic and social usage of water resources, i.e. value added generated by the use of water in the main sectors of the economy, and distribution network losses.  
  
  
  
The distribution efficiency of water systems is implicit within the calculations and could be made explicit if needed and where data are available.  
  
  
  
This indicator addresses specifically the target component “substantially increase water-use efficiency across all sectors”, by measuring the output per unit of water from productive uses of water as well as losses in municipal water use. It does not aim at giving an exhaustive picture of the water utilization in a country. Other indicators, specifically those for Targets 1.1, 1.2, 2.1, 2.2, 5.4, 5.a, 6.1, 6.2, 6.3, 6.5 will complement the information provided by this indicator. In particular, the indicator needs to be combined with the water stress indicator 6.4.2 to provide adequate follow-up of the target 6.4.  
  
  
  
Together, the three sectoral efficiencies provide a measure of overall water efficiency in a country. The indicator provides incentives to improve water use efficiency through all sectors, highlighting those sectors where water use efficiency is lagging behind.  
  
  
  
The interpretation of the indicator would be enhanced by the utilization of supplementary indicators to be used at country level. Particularly important in this sense would be the indicator on efficiency of water for energy and the indicator on the efficiency of the municipality distribution networks.  
  
  
  
Concepts:  
  
Water use: water that is received by an industry or households from another industry or is directly abstracted. [SEEA-Water (ST/ESA/STAT/SER.F/100), par. 2.21]  
  
  
  
Water abstraction: water removed from the environment by the economy. [SEEA-Water (ST/ESA/STAT/SER.F/100), par. 2.9]  
  
  
  
Water use for irrigation (km³/year)   
  
Annual quantity of water used for irrigation purposes. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater, direct use of agricultural drainage water, (treated) wastewater, and desalinated water. [AQUASTAT Glossary]  
  
  
  
Water use for livestock (watering and cleaning) (km³/year)   
  
Annual quantity of water used for livestock purposes. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater, direct use of agricultural drainage water, (treated) wastewater, and desalinated water. It includes livestock watering, sanitation, cleaning of stables, etc. If connected to the public water supply network, water used for livestock is included in the services water use. [AQUASTAT Glossary]  
  
  
  
Water use for aquaculture (km³/year)   
  
Annual quantity of water used for aquaculture. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater, direct use of agricultural drainage water, (treated) wastewater, and desalinated water. Aquaculture is the farming of aquatic organisms in inland and coastal areas, involving intervention in the rearing process to enhance production and the individual or corporate ownership of the stock being cultivated. [AQUASTAT Glossary]  
  
  
  
Water use for the MIMEC sectors (km³/year)  
  
Annual quantity of water used for the MIMEC sector. It includes water from renewable freshwater resources, as well as over-abstraction of renewable groundwater or abstraction of fossil groundwater and use of desalinated water or direct use of (treated) wastewater. This sector refers to self-supplied industries not connected to the public distribution network. [AQUASTAT Glossary. To be noted that in AQUASTAT, the sectors included in the MIMEC group are referred to as “industry”]  
  
  
  
Water use for the services sectors (km³/year)  
  
Annual quantity of water used primarily for the direct use by the population. It includes water from renewable freshwater resources, as well as over-abstraction of renewable groundwater or abstraction of fossil groundwater and the use of desalinated water or direct use of treated wastewater. It is usually computed as the total water used by the public distribution network. It can include that part of the industries, which is connected to the municipal network. [AQUASTAT Glossary. To be noted that in AQUASTAT, the sectors included in “services” are referred to as “municipal”]  
  
  
  
Value added (gross)  
  
Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The industrial origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 4. [WB Databank, metadata glossary, modified]  
  
  
  
Arable land  
  
Arable land is the land under temporary agricultural crops (multiple-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category. Data for “Arable land” are not meant to indicate the amount of land that is potentially cultivable. [FAOSTAT]  
  
  
  
Permanent crops  
  
Permanent crops are the land cultivated with long-term crops which do not have to be replanted for several years (such as cocoa and coffee); land under trees and shrubs producing flowers, such as roses and jasmine; and nurseries (except those for forest trees, which should be classified under "forest"). Permanent meadows and pastures are excluded from land under permanent crops. [FAOSTAT]  
  
  
  
Proportion of irrigated land on the total cultivated land  
  
Part of cultivated land that is equipped for irrigation, expressed in percentage  
  
  
  
Comments and limitations:  
  
The corrective coefficient Cr for the agricultural sector is needed in order to focus the indicator on the irrigated production. This is done for two main reasons:  
  
To ensure that only runoff water and groundwater (so-called blue water) are considered in computing the indicator;  
  
To eliminate a potential bias of the indicators, which otherwise would tend to decrease if rainfed cropland is converted to irrigated.  
  
  
  
Methodology  
  
  
  
Computation Method:  
  
Water use efficiency is computed as the sum of the three sectors listed above, weighted according to the proportion of water used by each sector over the total use. In formula:  
  
  
  
  
  
Where:  
  
WUE = Water use efficiency  
  
Awe = Irrigated agriculture water use efficiency [USD/m3]  
  
Mwe = MIMEC water use efficiency [USD/m3]  
  
Swe = Services water use efficiency [USD/m3]  
  
PA = Proportion of water used by the agricultural sector over the total use  
  
PM = Proportion of water used by the MIMEC sector over the total use  
  
PS = Proportion of water used by the service sector over the total use  
  
  
  
The computing of each sector is described below.  
  
Water use efficiency in irrigated agriculture is calculated as the agricultural value added per agricultural water use, expressed in USD/m3.   
  
In formula:  
  
  
  
  
  
Where:  
  
Awe = Irrigated agriculture water use efficiency [USD/m3]  
  
GVAa = Gross value added by agriculture (excluding river and marine fisheries and forestry) [USD]  
  
Cr = Proportion of agricultural GVA produced by rainfed agriculture   
  
Va = Volume of water used by the agricultural sector (including irrigation, livestock and aquaculture) [m3]  
  
   
  
The volume of water used by the agricultural sectors (V) is collected at country level through national records and reported in questionnaires, in units of m3/year (see example in AQUASTAT http://www.fao.org/nr/water/aquastat/sets/aq-5yr-quest\_eng.xls). Agricultural value added in national currency is obtained from national statistics, converted to USD and deflated to the baseline year.  
  
  
  
Cr can be calculated from the proportion of irrigated land on the total Arable land and Permanent crops (hereinafter “cultivated land”, as follows:  
  
  
  
Where:  
  
Ai = proportion of irrigated land on the total cultivated land, in decimals  
  
0.375 = generic default ratio between rainfed and irrigated yields  
  
More detailed estimations are however possible and encouraged at country level.  
  
  
  
Water efficiency of the MIMEC sectors (including power production): MIMEC value added per unit of water used for the MIMEC sector, expressed in USD/m3.  
  
  
  
In formula:  
  
  
  
Where:  
  
Mwe = Industrial water use efficiency [USD/m3]  
  
GVAm = Gross value added by MIMEC (including energy) [USD]  
  
Vm = Volume of water used by MIMEC (including energy) [m3]  
  
  
  
MIMEC water use (Vm) is collected at country level through national records and reported in questionnaires, in units of m3/year (see example in AQUASTAT http://www.fao.org/nr/water/aquastat/sets/aq-5yr-quest\_eng.xls). MIMEC value added is obtained from national statistics, deflated to the baseline year.  
  
  
  
Services water supply efficiency is calculated as the service sector value added (ISIC 36-39 and ISIC 45-98) divided by water used for distribution by the water collection, treatment and supply industry (ISIC 36), expressed in USD/m3.  
  
  
  
In formula:  
  
  
  
Where:  
  
 Swe = Services water use efficiency [USD/m3]  
  
 GVAs = Gross value added by services [USD]  
  
 Vs = Volume of water used by the service sector [m3]  
  
   
  
Data on volumes of used and distributed water are collected at country level from the municipal supply utilities records and reported in questionnaires, in units of km3/year or million m3/year (see example in AQUASTAT http://www.fao.org/nr/water/aquastat/sets/aq-5yr-quest\_eng.xls). Services value added is obtained from national statistics, deflated to the baseline year.  
  
  
  
Change in water use efficiency (CWUE) is computed as the ratio of water use efficiency (WUE) in time t minus water use efficiency in time t-1, divided by water use efficiency in time t-1 and multiplied by 100:  
  
  
  
  
  
  
  
It must be noted that computing the indicator in an aggregated manner, i.e. total GDP over total water use, would lead to an overestimation of the indicator. That is due to the fact that, for the agricultural sector, only the value produced under irrigation has to be counted in calculating the indicator. Hence, the sum of the value added of the various sectors used in these formulas is not equivalent to the total GDP of the country.  
  
  
  
Disaggregation:  
  
The indicator covers all the economic sectors according to the ISIC classification, providing the means for more detailed analysis of the water use efficiency for national planning and decision-making.   
  
  
  
Although the subdivision into three major aggregated economic sectors as defined in chapter 3 is sufficient for the purpose of compiling the indicator, wherever possible it is advisable to further disaggregate the indicator, according to the following criteria:  
  
  
  
Economically, a more refined subdivision of the economic sector can be done using ISIC Rev.4 by the following groups:  
  
Agriculture, Forestry and Fisheries (ISIC A);   
  
Mining and Quarrying (ISIC B);   
  
Manufacturing (ISIC C);  
  
Electricity, Gas, Steam and Air Conditioning Supply (ISIC D);   
  
Water Supply, Sewerage, Waste Management and Remediation Activities (ISIC E), by  
  
Water Collection, Treatment and Supply (ISIC 36)   
  
Sewerage (ISIC 37)  
  
Construction (ISIC F)  
  
Other industries (sum of remaining industries)  
  
Geographically, computing the indicator by river basin, watershed or administrative units within a country.  
  
  
  
These levels of disaggregation, or a combination of those, will give further insight on the dynamics of water use efficiency, providing information for remedial policies and actions.  
  
  
  
Treatment of missing values:  
  
At country level  
  
If scattered data (over time) are available, a methodology will be developed with regards to inter- and extrapolation.  
  
  
  
At regional and global levels  
  
If country data are missing, the value of the indicator will be considered in the average of the others in the same region.  
  
  
  
Regional aggregates:  
  
The aggregation for global and regional estimations is done by summing up the values of the various parameters constituting the elements of the formula, i.e. value added by sector and water use by sector. The aggregated indicator is then calculated by applying the formula with those aggregated data, as if it were a single country.  
  
  
  
An Excel sheet with the calculations is being prepared, and will be shared with the IAEG if required.  
  
  
  
Sources of discrepancies:  
  
Regional differences, in particular in relation to irrigated agriculture and different climatic conditions (including variability), are to be considered in the interpretation of this indicator, especially in countries with large amounts of available water resources. Also for this reason, coupling this indicator with water stress (6.4.2) is important for the interpretation of the data.  
  
  
  
Obtaining internationally comparable data for global monitoring  
  
Data for this indicator are collected through a questionnaire/calculation sheet that allows countries to identify the needed parameters, and provide some preliminary control checks.  
  
The data so collected are then reviewed by FAO experts, also through the GEMI team if needed. The finding of the review is then shared with the country, in order to ensure consistency and harmonization of methods, definitions and results.  
  
  
  
FAO has prepared a Step-by-step methodological paper, in order to provide a technical guide for the country teams. Moreover, an e-learning tool, in the form of a course on-line, is being prepared and will be ready early in 2018. Finally, an overall manual is being drafted.  
  
  
  
Methods and guidance available to countries for the compilation of the data at the national level:  
  
NA  
  
  
  
Quality assurance  
  
NA  
  
  
  
Data Sources  
  
  
  
The data needed for the compilation of the indicator are administrative data collected at country level by the relevant institutions, either technical (for water and irrigation) or economic (for value added).  
  
Those data are then compiled by FAO, World Bank, UNSD and other international institutions, harmonized and published in sectoral databases such FAO’s AQUASTAT, WB’s Databank and UNSD’s UNdata.  
  
  
  
Examples of the questionnaires that can be used include:  
  
  
  
AQUASTAT  
  
http://www.fao.org/nr/water/aquastat/sets/index.stm#main   
  
http://www.fao.org/nr/water/aquastat/sets/aq-5yr-guide\_eng.pdf   
  
  
  
SEEA Water  
  
SEEA-Water: https://seea.un.org/sites/seea.un.org/files/seeawaterwebversion\_final\_en.pdf   
  
SEEA Central Framework: https://seea.un.org/sites/seea.un.org/files/seea\_cf\_final\_en.pdf   
  
  
  
SEEA Technical Note on water (draft)  
  
https://seea.un.org/sites/seea.un.org/files/technical\_note\_water\_26\_05\_2016.pdf   
  
  
  
IRWS  
  
https://seea.un.org/sites/seea.un.org/files/irws\_en.pdf   
  
  
  
UNSD/UNEP Questionnaire on Environment Statistics – Water Section  
  
http://unstats.un.org/unsd/environment/questionnaire.htm   
  
http://unstats.un.org/unsd/environment/qindicators.htm   
  
  
  
OECD and Eurostat Joint Questionnaire on Inland Waters  
  
http://ec.europa.eu/eurostat/web/environment/water   
  
  
  
Source for GDP  
  
UNSD: http://unstats.un.org/unsd/snaama/selbasicFast.asp  
  
  
  
Data Availability  
  
  
  
Presently, the data needed for the indicator are collected by AQASTAT and the other databases for 168 countries worldwide.  
  
  
  
Breakdown of the number of countries covered by region is as follows:  
  
  
  
World  
  
168  
  
  
  
Africa  
  
51  
  
  
  
Northern Africa  
  
6  
  
  
  
Sub-Saharan Africa  
  
45  
  
  
  
Eastern Africa  
  
16  
  
  
  
Middle Africa  
  
8  
  
  
  
Southern Africa  
  
5  
  
  
  
Western Africa  
  
16  
  
  
  
Americas  
  
30  
  
  
  
Latin America and the Caribbean  
  
28  
  
  
  
Caribbean  
  
8  
  
  
  
Latin America  
  
20  
  
  
  
Northern America  
  
2  
  
  
  
Asia  
  
46  
  
  
  
Central Asia  
  
5  
  
  
  
Eastern Asia  
  
5  
  
  
  
Southern Asia  
  
8  
  
  
  
South-Eastern Asia  
  
10  
  
  
  
Western Asia  
  
18  
  
  
  
Europe  
  
37  
  
  
  
Eastern Europe  
  
10  
  
  
  
Northern Europe  
  
10  
  
  
  
Southern Europe  
  
10  
  
  
  
Western Europe  
  
7  
  
  
  
Oceania  
  
4  
  
  
  
Australia and New Zealand  
  
2  
  
  
  
Melanesia  
  
2  
  
  
  
Micronesia  
  
0  
  
  
  
Polynesia  
  
0  
  
  
  
  
  
  
  
Calendar  
  
  
  
Data collection:  
  
 The source collection is on-going in the context of the Integrated Monitoring Initiative (GEMI)  
  
   
  
Data release:  
  
November 2018  
  
  
  
Data providers  
  
  
  
Data collection is done with different modalities in different countries. Technical and economic institutions provide their relevant data, sometimes through the National Statistical Office (NSO), particularly for the economic data.  
  
  
  
Although data collection and its modality remains ultimately a responsibility of each country, FAO is working to promote a more regular involvement of NSOs, in order to ensure strongest consistency and robustness of the data provided.  
  
  
  
The list of National Focal Points for those countries involved through the GEMI project is in annex.  
  
  
  
Data compilers  
  
FAO (through AQUASTAT), on behalf of UN-Water. The monitoring of this indicator will be integrated into the GEMI initiative, which together with JMP and GLAAS, under the UN-Water umbrella, will provide a coherent framework for global monitoring of SDG 6.  
  
  
  
References  
  
AQUASTAT main page: http://www.fao.org/nr/water/aquastat/main/index.stm  
  
AQUASTAT glossary: http://www.fao.org/nr/water/aquastat/data/glossary/search.html  
  
AQUASTAT Main country database: http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en   
  
AQUASTAT Water use: http://www.fao.org/nr/water/aquastat/water\_use/index.stm  
  
AQUASTAT Water resources: http://www.fao.org/nr/water/aquastat/water\_res/index.stm  
  
AQUASTAT publications dealing with concepts, methodologies, definitions, terminologies, metadata, etc.: http://www.fao.org/nr/water/aquastat/catalogues/index.stm  
  
AQUASTAT Quality Control: http://www.fao.org/nr/water/aquastat/sets/index.stm#main  
  
AQUASTAT Guidelines: http://www.fao.org/nr/water/aquastat/sets/aq-5yr-guide\_eng.pdf  
  
FAOSTAT production database: http://faostat3.fao.org/download/Q/\*/E  
  
UNSD/UNEP Questionnaire on Environment Statistics – Water Section  
  
http://unstats.un.org/unsd/environment/questionnaire.htm  
  
http://unstats.un.org/unsd/environment/qindicators.htm   
  
Framework for the Development of Environment Statistics (FDES 2013) (Chapter 3): http://unstats.un.org/unsd/environment/FDES/FDES-2015-supporting-tools/FDES.pdf  
  
International Recommendations for Water Statistics (IRWS) (2012): http://unstats.un.org/unsd/envaccounting/irws/  
  
OECD/Eurostat Questionnaire on Environment Statistics – Water Section: http://ec.europa.eu/eurostat/web/environment/water  
  
OECD National Accounts data files: http://www.oecd-ilibrary.org/economics/data/oecd-national-accounts-statistics\_na-data-en  
  
SEEA-Water: https://seea.un.org/sites/seea.un.org/files/seeawaterwebversion\_final\_en.pdf  
  
SEEA Central Framework: https://seea.un.org/sites/seea.un.org/files/seea\_cf\_final\_en.pdf   
  
UNSD National Accounts Main Aggregates Database: http://unstats.un.org/unsd/snaama/selbasicFast.asp  
  
World Bank Databank (World Economic Indicators) http://databank.worldbank.org/data/home.aspx  
  
ISIC rev. 4: https://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27  
  
  
  
  
  
  
  
Related indicators as of February 2020  
  
This indicator needs to be combined with the water stress indicator 6.4.2 to provide adequate follow-up of the target 6.4.  
  
  
  
Other indicators, specifically those for Targets 1.1, 1.2, 2.1, 2.2, 5.4, 5.a, 6.1, 6.2, 6.3, 6.5 will complement the information provided by this indicator.

Last updated: 11 July 2017  
  
  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target 6.5: By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate  
  
Indicator 6.5.1: Degree of integrated water resources management  
  
  
  
Institutional information  
  
  
  
Organization(s):  
  
  
  
United Nations Environment Programme (UNEP)  
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
  
  
The indicator degree of implementation of Integrated Water Resources Management (IWRM), measured in per cent (%) from 0 (implementation not yet started) to 100 (fully implemented) is currently being measured in terms of different stages of development and implementation of Integrated Water Resources Management (IWRM).   
  
  
  
The definition of IWRM is based on an internationally agreed definition, and is universally applicable. IWRM was officially established in 1992 and is defined as “a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.” (GWP 2010).   
  
  
  
The method builds on official UN IWRM status reporting, from 2008 and 2012, of the Johannesburg Plan of Implementation from the UN World Summit for Sustainable Development (1992).  
  
  
  
Rationale:  
  
  
  
The indicator provides a direct progress measurement of the first part of Target 6.5 “…implement integrated water resources management at all levels …”. The percentage score provides an easy and understandable way of measuring progress towards the target, with ‘0’ interpreted as no implementation of IWRM, and ‘100’ interpreted as IWRM being fully implemented.   
  
  
  
To further aid interpretation and comparison, the indicator results can be categorized in a similar way to the survey questions: Degree of implementation =   
  
  
  
Very low (0-9.9)  
  
Low (10-29.9)  
  
Medium-low (30-49.9)  
  
Medium-high (50-69.9)  
  
High (70-89.9)  
  
Very high (90-100)  
  
  
  
The concept of the survey is that it provides sufficient information to be of real value to the countries in determining their progress towards the target, and through this, various aspects of IWRM. A balance has been sought between providing sufficient information to cover the core principles of IWRM, and thus providing a robust indicator value, and not overburdening countries with unnecessary reporting requirements.   
  
  
  
Countries are encouraged to provide additional information on each question, which may help to qualify their choice of score, and/or put that score into their national context.   
  
  
  
Indicator 6.5.1 is supported by indicator 6.5.2 “Proportion of transboundary basin area with an operational arrangement for water cooperation”, which directly addresses the portion of Target 6.5 “…, including through transboundary cooperation as appropriate.”.  
  
  
  
Concepts:  
  
  
  
The concept of IWRM is measured in 4 main components:   
  
  
  
Enabling environment: this includes the policies, laws, plans and strategies which create the ‘enabling environment’ for IWRM.   
  
Institutions: includes the range and roles of political, social, economic and administrative institutions that help to support the implementation of IWRM.   
  
Management Instruments: The tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions.   
  
Financing: Budgeting and financing made available and used for water resources development and management from various sources.  
  
  
  
The indicator is based on a national survey structured around these four main components (UNEP 2016). Each component is split into two parts: questions concerning the ‘National level’ and ‘Other levels’ respectively. ‘Other levels’ includes sub-national (including provinces/states for federated countries), basin level, and the transboundary level as appropriate. These two parts address the wording of Target 6.5 ‘implement [IWRM] at all levels …’.  
  
  
  
Comments and limitations:  
  
  
  
The challenge of subjectivity in responses associated with this type of survey is being addressed in a number of ways:   
  
  
  
Draft responses are reviewed by a number of governmental and non-governmental stakeholders in an open, inclusive and transparent process.   
  
Countries are encouraged to provide further information to qualify their responses and/or set them in the national context.   
  
Guidelines are provided for each of the four main components, each question, and each of the six thresholds for every single question, to ensure responses are as objective as possible, and are comparable both between countries, and between reporting periods.   
  
  
  
To achieve robust indicator results requires a country process involving a wide range of stakeholders which will require a certain amount of time and resources. The advantage of this is that it puts in place a process that addresses the integrated and indivisible nature of the SDG targets, as well as stressing the importance of “leaving no on behind”.  
  
  
  
Methodology  
  
  
  
Computation Method:  
  
  
  
The survey contains 32 questions divided into the four main components described above.   
  
Each question is given a score between 0 and 100, in increments of 10, based on the following 6 main categories:  
  
Very low (0)  
  
Low (20)  
  
Medium-low (40)  
  
Medium-high (60)  
  
High (80)  
  
Very high (100)  
  
Note that guidance is provided for each threshold for each question, to ensure objective and comparable results.   
  
  
  
The un-weighted average of the question scores within each of the four components is calculated to give a score of 0 – 100 for each component.   
  
The component scores are averaged (un-weighted) to give the indicator score, expressed as a percentage between 0 and 100.  
  
  
  
Disaggregation:  
  
  
  
The strength of the indicator lies in the potential for disaggregating the country score into the four main components of IWRM, and further to the questions in the survey. This provides countries with a quick assessment of which aspects of IWRM are progressing well, and which aspects require increased efforts to obtain the target.   
  
  
  
The nature of the target, indicator and survey does not lend itself to disaggregation by sex, age group, income etc. However, social equality is an integral part of IWRM, and there are questions which directly address issues such as gender, vulnerable groups, geographic coverage and broad stakeholder participation in water resources development and management. These questions provide an indication of the national and sub-national situation regarding social equality.  
  
  
  
Treatment of missing values:  
  
  
  
At country level  
  
  
  
The indicator and survey have been designed for all countries to be able to submit an indicator value. A number of countries that did not submit a survey during the last round of data collection included fragile states / countries in conflict, or small island developing states. It is therefore estimated that the number of country responses under the SDG process will be in excess of 90%. Estimates for countries not responding to the survey will therefore not be made.  
  
  
  
At regional and global levels  
  
  
  
It is estimated that the number of country responses will be in excess of 90%. This coverage of data will be deemed to be representative of global aggregates. Estimates for countries not responding to the survey will therefore not be made.  
  
  
  
Regional aggregates:  
  
  
  
Following the Agenda 2030 principle of “leaving no one behind”, regional and global values will be based on simple, un-weighted averages of country scores. The country scores will be presented as a percentage, and regional and global averages will also be presented as a percentage. Global averages will be based on country values, not regional averages.   
  
  
  
Regional values may be assembled by regional bodies responsible for water resources in the region, such as the African Ministerial Council on Water (AMCOW), and the European Environment Agency (EEA).  
  
  
  
Sources of discrepancies:  
  
  
  
As described in section 11, there will be no internationally estimated data, with all data to be produced by countries.  
  
  
  
Methods and guidance available to countries for the compilation of the data at the national level:  
  
  
  
National focal points selected by each country.   
  
Data collection is via a simple questionnaire with 32 questions. Responses can be submitted either online via SurveyMonkey or emailed using a MS Word format. Responses to each question are to be given on a scale of 0 – 100, in increments of 10. Threshold descriptions are given for six thresholds between 0 and 100.   
  
National focal points are responsible for coordinating a national process to engage governmental and non-governmental stakeholders, as appropriate in the context of each country, to develop draft responses and finalise responses. This may be via email, workshops, and online notices. The following materials are available for national focal points in 5 languages (English, Spanish, French, Arabic, Russian, Chines), at http://iwrmdataportal.unepdhi.org/iwrmmonitoring.html: a detailed step-by-step guide; the questionnaire in MS Word and electronic formats; and webinar presentations and videos.   
  
  
  
Extensive explanations are provided in the step-by-step guide, the webinars, and in the questionnaire itself. The questionnaire contains: an overall introduction and explanation; a glossary; an introduction and glossary in each of the four sections; threshold descriptions for six thresholds for each question; and a number of footnotes to explain aspects of questions or threshold descriptions. All materials can be downloaded from http://iwrmdataportal.unepdhi.org/iwrmmonitoring.html. In addition, a dedicated helpdesk is available to provide assistance at all times. The helpdesk is accessible via email <Iwrm.Sdg6survey@unep.org>.  
  
  
  
Quality assurance:  
  
  
  
The following quality assurance guidelines are available to all individuals involved in quality assurance for 6.5.1. Process:   
  
Nominate person responsible for QA for a country response once it is submitted for the first time.   
  
Acknowledge receipt and inform the country of QA process.   
  
Update spreadsheet ‘Country\_scores\_QC.xlsx’, indicating date of receipt and who submitted.   
  
Upload Word versions, or Suvery Monkey versions as PDF, to the dropbox folder 6.5.1.IWRM 2017 Country Survey> 6.5.1 Country Questionnaire Submissions.   
  
Undertake ALL checks described below.   
  
If there are any discrepancies, revert to UNEP-DHI colleagues.   
  
Once action is agreed, respond to the countries.   
  
Complete all checks on each subsequent version of the questionnaire until all quality issues are resolved and questionnaire is marked ‘final’.      
  
  
  
Checks:   
  
Focal point: Confirm the person submitting is the formal national focal point. If not, any reply should also add the national focal point in CC.    
  
Question responses:   
  
All questions answered. Official guidance is that all questions should be answered (either with a score or n/a).   
  
Scores in range from 0-100, in increments of 10.   
  
Check that n/a (not applicable) is used appropriately.   
  
Justification/evidence fields:   
  
Check that the free text make sense in the context of the score (and vice versa).   
  
If n/a is used appropriately, or if a score of 100 is given, check that a justification is provided, as per instructions in the questionnaire   
  
Calculations: Check that section averages are correct and that final average is correct, using the spreadsheet ‘Country\_scores\_QC.xlsx’ on Dropbox. Fill in the given responses in columns M - AX, and the differences are calculated automatically in columns C – G. If the difference is greater than +/- 0.5, the cells are automatically highlighted in red using conditional formatting.   
  
Compare with 2011: Compare with 2011 and discuss with colleagues if necessary. Use file ‘2011\_IWRM\_Data\_for\_SDG\_comparison.xlsx’, on Dropbox, which has rescaled the 2011 results to 0-100, and selected the individual questions, or groups of questions, which are comparable to the 2017 SDG version, as described in the file SDG\_6.5.1\_vs\_2011-IWRM\_questions.pdf, on Dropbox.    
  
Transboundary issues:   
  
Check the ‘transboundary basins’ table in the introductory section. A full list of transboundary basins can be found here: http://twap-rivers.org/indicators/Report.ashx?type=IndicatorResultsSummary. Go to the final worksheet/tab to see the countries in each basin. Also check the maps here: http://twap-rivers.org/indicators/ to see if the basin is likely to be important for that country, or if there is only a small portion of the basin in their country (in which case they may not list it).   
  
Check the transboundary questions: 2.2d; 2.2e; 3.2d; and 4.2c, and see if these make sense in the context of the country. Island countries should give ‘n/a’ for all of these questions.  
  
  
  
All data is provided by each country and is therefore fully owned by the countries. Each country undertakes stakeholder consultation, to a level that is appropriate given resources and capacity available to them, to ensure that the data has adequate acceptance and ownership within the country. Guidance on consultation processes are provided in the step-by-step guide and through the inception webinar (all materials available at http://iwrmdataportal.unepdhi.org/iwrmmonitoring.html).  
  
  
  
Data Sources  
  
  
  
Description:  
  
  
  
Monitoring progress on meeting SDG 6.5 is owned by and is the responsibility of the national government. The government will assign a ministry with the primary responsibility for overseeing this survey, which will be asked to take on the responsibility of coordinating the national IWRM monitoring and reporting process. As water issues, and water management issues in particular, cut across a wide number of sectors, often overseen by different ministries and other administrative bodies at national or other levels, the process should be inclusive. Major stakeholders should be involved in order to contribute to well informed and objective answers to the questionnaire.   
  
  
  
The ministry may wish to nominate a national “IWRM focal point”, who may or may not be a government official. The UN will provide support where needed and possible. The following steps are suggested as guidance only, as it is up to countries to decide which process or processes would best serve their needs. It should also be noted that the following steps represent a ‘ladder’ approach, in that completing all the steps will generally lead to a more robust indicator. However, it may not be possible or necessary for all countries to complete all steps.   
  
  
  
The responsible ministry or IWRM focal point contacts other relevant ministries/agencies to compile responses to the questionnaire. Each possible response option has a score which will be used to calculate the overall indicator score.  
  
The completed draft questionnaire is reviewed by government stakeholders. These stakeholders could include those involved in water-relevant sectors, such as agriculture, energy, water supply and environment, as well as water management at different administrative levels. This process may be electronic (e.g. via email) and/or through workshops.   
  
The revised draft questionnaire is validated at a multi-stakeholder workshop. Apart from government representatives these stakeholders could include water user associations, private sector, interest groups concerned with e.g. environment, agriculture, poverty, and academia. The suggested process is through a workshop but alternative means of consultation e.g. email, online call for public submissions could be considered. Note that steps 2 and 3 could be combined if desired.   
  
The responsible ministry or IWRM focal point discusses with relevant officials and consolidates the input into a final version. This version will be the basis for calculating the degree of IWRM implementation (0-100) for global reporting. Countries can enter responses electronically into an online version of the survey, which will automatically calculate the degree of IWRM implementation score, and also generate graphs and automatic reports to help countries identify areas for attention.   
  
The responsible ministry submits the final indicator score to the national statistics office responsible for compiling all national SDG target data.   
  
  
  
Based on the national survey, UN-Water will periodically prepare synthesis reports for regional and global levels to provide overall progress on meeting SDG target 6.5.   
  
  
  
Temporal Coverage: A reporting cycle of three years is recommended.  
  
  
  
Collection process:  
  
  
  
Official counterparts at the country level and the validation and consultation process.   
  
  
  
The survey has been designed so that the indicator is comparable between countries and time periods. No adjustments are foreseen.  
  
  
  
Data Availability  
  
  
  
Description:  
  
  
  
Total number of countries: 133 (69% of UN Member States) (UN-Water 2012)   
  
  
  
The following covers the region (MDG regional groupings): followed by the number of countries with data (/total countries in region) (as of 2012); followed by the percentage of countries with data  
  
Oceania: 5/12; 42%  
  
Eastern Asia: 4/4; 100%  
  
Southern Asia: 5/9; 56%  
  
South-Eastern Asia: 9/11; 82%  
  
Western Asia: 5/12; 42%  
  
Caucasus and Central Asia: 5/8; 63%  
  
Latin America & the Caribbean: 22/33; 67%  
  
Developed regions: 38/50; 76%  
  
Sub-Saharan Africa: 35/49; 71%  
  
Northern Africa: 5/5; 100%  
  
World: 133/193; 69%  
  
  
  
Time series:  
  
  
  
2008, 2012 (UN-Water 2008, 2012, IWRM Data Portal)  
  
  
  
Calendar  
  
  
  
Data collection:  
  
  
  
December 2016 – August 2017 (9 months).   
  
  
  
Data release:  
  
  
  
1st quarter 2018.  
  
  
  
Data providers  
  
  
  
The information required to complete the survey is expected to be held by government officials responsible for water resources management in the country, supported by official documentation. E.g. Ministry of Water in coordination with Ministry of Environment, Ministry of Finance, Ministry of Planning, Ministry of Lands and Agriculture, Ministry of Industry and Mining etc. See also section 6 above. As a minimum, a small group of officials may be able to complete the survey. However, these government officials may belong to various government authorities, and coordination will be required to determine and validate the responses to each question. Increased government and non-government stakeholder participation in validating the question scores will lead to a more robust indicator score and facilitate tracking progress over time.  
  
  
  
Data compilers  
  
  
  
UNEP and UN-Water partners, under GEMI (Integrated Monitoring of Water and Sanitation Related Targets)  
  
  
  
References  
  
  
  
URL:  
  
  
  
http://www.unepdhi.org  
  
  
  
References:  
  
  
  
- AMCOW 2012: Status Report on Water Resources Management in Africa, http://www.amcow-online.org/index.php?option=com\_content&view=article&id=262&Itemid=141&lang=en   
  
  
  
- GEMI – Integrated Monitoring of Water and Sanitation-related SDG Targets. http:/  
  
  
  
Related indicators as of February 2020  
  
  
  
As it measures the degree of implementation of an enabling environment for better water resources management, it directly supports the other outcome targets under SDG 6 (6.1 – 6.6). It does this by providing further information to countries on the context and possible explanation for the progress on other targets, and points to barriers and enablers to obtaining the other targets. It also directly supports the means of implementation targets 6.a and 6.b, as disaggregation is possible to provide data on financing (6.a) and stakeholder participation (6.b). Beyond SDG 6, indicator 6.5.1 has linkages with a number of other targets across the SDGs, as integrated water resources management is concerned with integrating the demands and impacts on water resources and water-related ecosystems from a number of different SDGs and their targets, including: poverty (1.4); agriculture (2.3); education (4.7); gender (5.5); energy (7.1); work (8.5); equality (10.2); urban areas (11.3); climate change (13.2); ecosystems (15.9); governance (16.3, 16.5 – 16.7) (UN-Water 2016).

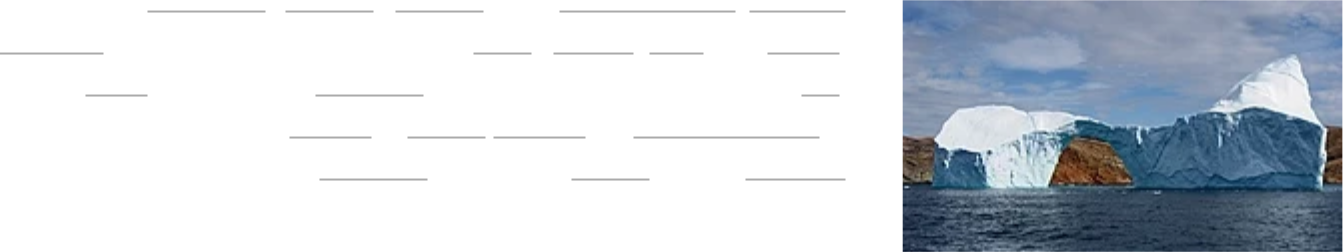
Last updated: 09 May 2018  
  
Goal 6: Ensure availability and sustainable management of water and sanitation for all  
  
Target: 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.  
  
Indicator: 6.3.2 Proportion of bodies of water with good ambient water quality  
  
  
  
Institutional information  
  
  
  
Organization(s):  
  
UN Environment (United Nations Environment Programme)  
  
  
  
Concepts and definitions  
  
  
  
Definition:  
  
The indicator is defined as the proportion of water bodies in the country that have good ambient water quality. Ambient water quality refers to natural, untreated water in rivers, lakes and groundwaters and represents a combination of natural influences together with the impacts of all anthropogenic activities. The indicator relies on water quality data derived from in situ measurements and the analysis of samples collected from surface and groundwaters. Water quality is assessed by means of core physical and chemical parameters that reflect natural water quality related to climatological and geological factors, together with major impacts on water quality. The continuous monitoring of all surface and groundwaters is economically unfeasible and not required to sufficiently characterize the status of ambient water quality in a country. Therefore, countries select river, lake and groundwater bodies that are representative and significant for the assessment and management of water quality to monitor and report on indicator 6.3.2. The quality status of individual water bodies is classified based on the compliance of the available water quality monitoring data for the core parameters with target values defined by the country. The indicator is computed as the proportion of the number of water bodies classified as having good quality (i.e. with at least 80 % compliance) to the total number of assessed water bodies, expressed as a percentage.   
  
   
  
Rationale:  
  
Good ambient water quality is essential for protecting aquatic ecosystems and the services they provide, including: the preservation of biodiversity; the protection of human health during recreational use and through the provision of drinking water; the support of human nutrition through the provision of fish and water for irrigation; the enabling of a variety of economic activities; and the strengthening of the resilience of people against water-related disasters. Good ambient water quality is therefore closely linked to the achievement of many other Sustainable Development Goals.  
  
  
  
Target 6.3 aims at improving water quality and indicator 6.3.2 provides a mechanism for determining whether, and to which extent, water quality management measures are contributing to the improvement of water quality over time. The indicator is also directly linked to indicator 6.3.1 on wastewater treatment because inadequate wastewater treatment leads to degradation in quality of the waters receiving the wastewater effluents. It directly informs progress towards target 6.3 and is strongly linked to target 6.6 on water-related ecosystems, as well as target 14.1 on marine pollution (coastal eutrophication).  
  
  
  
The methodology recognises that countries have different capacity levels to monitor water quality, with many developed countries operating extensive and complex programmes that collect and report data to existing reporting frameworks beyond the scope of this methodology. For these countries it is recognised that this methodology will not contribute to improving their water quality; however it must be sufficiently flexible to capture data from existing monitoring frameworks without burdening countries with additional reporting obligations. Conversely, many of the least developed countries currently do not monitor water quality or operate very limited monitoring programmes. The methodology must therefore allow these countries to contribute to the global indicator, according to their national capacity and available resources.   
  
  
  
The development of the methodology builds on best practice for water quality monitoring promoted by the UN Environment GEMS/Water programme since 1978 together with testing by several pilot countries during the Integrated Monitoring Initiative Proof of Concept phase of 2016, and external review by experts and international organizations. This led to revision of the original methodology, which was then further tested through the 2017 global data drive. The feedback received has contributed to the present refined methodology.  
  
  
  
Concepts:  
  
The concepts and definitions used in the methodology have been based on existing international frameworks and glossaries (WMO 2012) unless where indicated otherwise below.  
  
Aquifer: Geological formation capable of storing, transmitting and yielding exploitable quantities of water.   
  
Classification of water quality: If at least 80% of the monitoring values for prescribed parameters in a water body comply with their respective target values, the water body is classified as having a “good” water quality status. Each water body is classified as being of “good” or “not good” status.   
  
Groundwater: Subsurface water occupying the saturated zone.   
  
Groundwater body: A distinct volume of groundwater within an aquifer or aquifers (EU 2000). Groundwater bodies that cross river basin district (RBD) boundaries should be divided at the boundary with each separate portion of the groundwater body being reported separately along with its respective RBD.   
  
Lake: Inland body of standing surface water of significant extent.   
  
Non-point-source pollution: Pollution of water bodies from dispersed sources such as fertilizers, chemicals and pesticides used in agricultural activities.  
  
Parameter: Water quality variable or characteristic of water quality, also called a determinand.  
  
Point source pollution: Pollution with a precisely located origin.  
  
Pollution (of water): Introduction into water of any undesirable substance which renders the water unfit for its intended use.  
  
Pollutant: Substance which disrupts and interferes with the equilibrium of a water system and impairs the suitability of using the water for a desired purpose.   
  
Reservoir: Body of water, either natural or man-made, used for storage, regulation and control of water resources.  
  
River: Large stream which serves as the natural drainage for a basin.  
  
River basin: Geographical area having a common outlet for its surface runoff.  
  
River basin district: Area of land, made up of one or more neighbouring river basins together with their associated groundwaters (EU, 2000).  
  
River water body: A coherent section of a river that is discrete (does not overlap with another water body) and is significant rather than arbitrarily designated.   
  
Stream: Flowing body of water in a natural surface channel.  
  
Surface water: Water which flows over, or lies on, the ground surface. Note: Indicator 6.3.2 does not include the monitoring of water quality in wetlands under monitoring level 1.  
  
Target value: A value (or range) for any given water quality parameter that indicates the threshold for a designated water quality, such as good water quality rather than acceptable water quality.  
  
Toxic substance: Chemical substance which can disturb the physiological functions of humans, animals and plants.  
  
Transboundary waters: Surface or ground waters which mark, cross or are located on boundaries between two or more States; wherever transboundary waters flow directly into the sea, these transboundary waters end at a straight line across their respective mouths between points on the low-water line of the banks (UNECE, 1992).  
  
  
  
Water quality index: The measured water quality results for all parameters combined into a numeric value for each monitoring location. These scores are then aggregated over the time of the assessment period. The index score can range between zero (worst) to 100 (best).  
  
Comments and limitations:  
  
The monitoring and reporting of SDG Indicator 6.3.2 requires considerable national financial and human capacities to regularly measure water quality parameters at sufficient spatial and temporal resolutions, and to consistently collect, quality-assure and process the monitoring data to compute the indicator. Substantial investments in monitoring and data management infrastructures, as well as targeted capacity development in water quality monitoring programme design and operation, will be required in many countries to enhance national capacities to regularly and consistently report on the indicator.   
  
  
  
Recognizing the differences in monitoring and data processing capacities among countries, the indicator methodology offers a progressive monitoring approach allowing countries to start with reporting based on their existing capacity and progressively enhance the data coverage and indicator significance with increasing capacity.  
  
Level 1 monitoring includes a set of general, easily measurable, physico-chemical water quality parameters that can indicate water quality degradation. They can be used to assess the quality status of water bodies, facilitating global comparability and maintaining a balance between the significance of the indicator and the monitoring requirements for each country.   
  
Level 2 monitoring allows countries with enhanced capacities to include additional water quality parameters, such as toxic substances and biological monitoring, as well as more sophisticated quality classification schemes to assess and report on the quality of their water bodies more accurately.  
  
  
  
Methodology  
  
Computation Method:  
  
The indicator is computed by first classifying all assessed water bodies based on the compliance of the monitoring data collected for selected parameters at monitoring locations within the water body with parameter-specific target values:   
  
  
  
Where  
  
 is the percentage compliance [%];  
  
 is the number of monitoring values in compliance with the target values;  
  
 is the total number of monitoring values.  
  
A threshold value of 80% compliance is defined to classify water bodies as “good” quality. Thus, a body of water is classified as having a good quality status if at least 80% of all monitoring data from all monitoring stations within the water body are in compliance with the respective targets.  
  
  
  
In a second step, the classification results are used to compute the indicator as the proportion of the number of water bodies classified as having a good quality status to the total number of classified water bodies expressed in percentage:  
  
  
  
Where  
  
 is the percentage of water bodies classified as having a good quality status;  
  
 is the number of classified water bodies classified as having a good quality status;  
  
 is the total number of monitored and classified water bodies.  
  
Disaggregation:  
  
The indicator can be disaggregated by water body type (river, lake, groundwater) and river basin district. This disaggregated data can support informed decision-making at the national and sub-national scale to monitor and improve water quality management measures.  
  
  
  
Treatment of missing values:  
  
  
  
At country level  
  
Missing values are not imputed.   
  
At regional and global levels  
  
Missing values are not imputed.  
  
  
  
Regional aggregates:  
  
http://pre-uneplive.unep.org/media/docs/graphs/aggregation\_methods.pdf.   
  
  
  
Sources of discrepancies:  
  
Not applicable as no internationally estimated data is used to impute.   
  
  
  
Data Sources  
  
Description:  
  
The recommended sources of data are water quality monitoring data derived from in situ measurements and the analysis of samples collected from surface and groundwaters in national or sub-national ambient water quality monitoring programmes implemented by governmental authorities. Additional water quality monitoring data from research or citizen-science monitoring programmes can be used to supplement the available authoritative monitoring data, provided they are authorised by the national reporting agency.  
  
  
  
The number of monitoring locations required to determine the quality status of a water body depends on the type and size of the water body, but a minimum of one monitoring location per water body is required. The minimum data requirements for calculating this indicator are measurements for all of the recommended or alternative core parameters appropriate to the type of water body as defined in the methodology.   
  
  
  
Measurements should be taken routinely, at prescribed intervals, or the same time of year each year, from the same locations. Even if new monitoring stations are introduced, data should continue to be collected from the original locations. This ensures that results are comparable between reports, thereby enabling trends to be established over time. The monitoring data needed for the indicator computation may be collected by different monitoring programmes involving different agencies and organizations. It is therefore important to establish and maintain centralized data repositories at the national level that collate the data from the various stakeholders, ensuring compatibility in reporting units between all agencies submitting data. Data should be compiled for each core parameter at each sampling location in order to calculate the indicator.  
  
   
  
Collection process:  
  
The data will be collected by UN Environment and its Global Environment Monitoring System for Water (GEMS/Water) through electronic reporting in the global water quality information system GEMStat. At the national level, data reports will be provided by the GEMS/Water National Focal Points or any other official counterpart appointed by the respective government. GEMS/Water offers consultation and support in selecting and compiling the required monitoring data, defining suitable river basin districts and delineating water bodies, as well as computing the indicator, upon request through its helpdesk. Data reported by the countries will be checked for consistency with respect to the monitoring parameters, target values and spatial units and compared with monitoring data available in GEMStat, if applicable.   
  
  
  
Data Availability  
  
Description:  
  
An initial baseline data collection has been conducted in 2017 with 48 country data submissions as of February 2018.  
  
  
  
Time series:  
  
The reporting on this indicator will follow a 5-year cycle.   
  
Initial baseline data collection completed in 2017; First reporting cycle in 2020: data collected from 2015 to 2019; Second reporting cycle in 2025: data collected from 2020 to 2024; Third reporting cycle in 2030: data collected from 2025 to 2029.  
  
  
  
Calendar  
  
Data collection:  
  
First reporting cycle: 2020;  
  
Second reporting cycle: 2025;  
  
Third reporting cycle: 2030.  
  
   
  
Data release:  
  
First reporting cycle: June 2021;  
  
Second reporting cycle: June 2026;  
  
Third reporting cycle: June 2031.  
  
  
  
Data providers  
  
GEMS/Water National Focal Points in relevant Ministries, Water Authorities, etc. or their nominated representative.  
  
  
  
Data compilers  
  
UN Environment (United Nations Environment Programme)   
  
  
  
References  
  
  
  
URL: http://www.sdg6monitoring.org/indicators/target-63/indicators632/  
  
  
  
References:  
  
EU (European Parliament, Council of the European Union) 2000. Water Framework Directive (WFD) 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, Official Journal L327, 1–72. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060  
  
UNECE 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Available at: http://www.unece.org/fileadmin/DAM/env/water/pdf/watercon.pdf  
  
WMO 2012 International Glossary of Hydrology. No. 385 World Meteorological Organization and United Nations Educational, Scientific and Cultural Organization. Available at: http://library.wmo.int/pmb\_ged/wmo\_385-2012.pdf   
  
  
  
Related indicators as of February 2020  
  
  
  
Indicators 6.3.1, 6.6.1, 14.1.1

**Water**



Water in two states: liquid (including the clouds, which are examples of [aerosols),](https://en.wikipedia.org/wiki/Aerosol) and solid [(ice)](https://en.wikipedia.org/wiki/Ice).

[**Water** is a transparent, tasteless, odorless, and nearly colorless chemical](https://en.wikipedia.org/wiki/Chemical_substance)[substance, which is the main constituent of](https://en.wikipedia.org/wiki/Chemical_substance) [Earth's](https://en.wikipedia.org/wiki/Earth) [streams,](https://en.wikipedia.org/wiki/Stream) [lakes,](https://en.wikipedia.org/wiki/Lake) [and](https://en.wikipedia.org/wiki/Chemical_substance) [oceans,](https://en.wikipedia.org/wiki/Ocean) and the [fluids](https://en.wikipedia.org/wiki/Fluid) of most living [organisms.](https://en.wikipedia.org/wiki/Organism) It is vital for all known forms of [life,](https://en.wikipedia.org/wiki/Life" \l "Range_of_tolerance) even though it provides no [calories](https://en.wikipedia.org/wiki/Food_energy) or [organic](https://en.wikipedia.org/wiki/Organic_compound) [nutrients.](https://en.wikipedia.org/wiki/Nutrient) Its [chemical formula](https://en.wikipedia.org/wiki/Chemical_formula) is H2O, meaning that each of its [molecules](https://en.wikipedia.org/wiki/Molecule) contains one [oxygen](https://en.wikipedia.org/wiki/Oxygen) and two [hydrogen](https://en.wikipedia.org/wiki/Hydrogen)



[atoms,](https://en.wikipedia.org/wiki/Atom) connected by [covalent bonds.](https://en.wikipedia.org/wiki/Covalent_bond) Water is the name of the liquid state of H2O at [standard ambient temperature and pressure.](https://en.wikipedia.org/wiki/Standard_ambient_temperature_and_pressure) It forms [precipitation](https://en.wikipedia.org/wiki/Precipitation) in the



form of [rain](https://en.wikipedia.org/wiki/Rain) and [aerosols](https://en.wikipedia.org/wiki/Aerosol) in the form of [fog.](https://en.wikipedia.org/wiki/Fog) [Clouds](https://en.wikipedia.org/wiki/Cloud) are formed from suspended droplets of water and [ice,](https://en.wikipedia.org/wiki/Ice) its solid state. When finely divided, crystalline [ice](https://en.wikipedia.org/wiki/Ice) may [precipitate in the form of snow. The gaseous state of water is steam or water](https://en.wikipedia.org/wiki/Water_vapor) [vapor. Water moves continually through the](https://en.wikipedia.org/wiki/Water_vapor) [water cycle](https://en.wikipedia.org/wiki/Water_cycle) [of](https://en.wikipedia.org/wiki/Water_vapor) [evaporation,](https://en.wikipedia.org/wiki/Evaporation)



[transpiration](https://en.wikipedia.org/wiki/Transpiration) [(evapotranspiration),](https://en.wikipedia.org/wiki/Evapotranspiration) [condensation,](https://en.wikipedia.org/wiki/Condensation) [precipitation,](https://en.wikipedia.org/wiki/Precipitation_(meteorology)) and [runoff,](https://en.wikipedia.org/wiki/Surface_runoff) usually reaching the sea.



Water covers 71% of the [Earth's](https://en.wikipedia.org/wiki/Earth) [surface,](https://en.wikipedia.org/wiki/Surface) mostly in [seas](https://en.wikipedia.org/wiki/Seas) and [oceans.](https://en.wikipedia.org/wiki/Oceans)[[1]](#page20) Small portions of water occur as [groundwater](https://en.wikipedia.org/wiki/Groundwater) (1.7%), in the [glaciers](https://en.wikipedia.org/wiki/Glaciers) and the [ice caps](https://en.wikipedia.org/wiki/Ice_caps) of [Antarctica](https://en.wikipedia.org/wiki/Antarctica) and [Greenland](https://en.wikipedia.org/wiki/Greenland) (1.7%), and in the [air](https://en.wikipedia.org/wiki/Atmosphere) as [vapor,](https://en.wikipedia.org/wiki/Vapor) [clouds](https://en.wikipedia.org/wiki/Clouds) (formed of ice and liquid water



suspended in air), and [precipitation](https://en.wikipedia.org/wiki/Precipitation_(meteorology)) (0.001%).[[2][3]](#page20)



Water plays an important role in the [world economy.](https://en.wikipedia.org/wiki/World_economy) Approximately 70% of the freshwater used by [humans](https://en.wikipedia.org/wiki/Humans) goes to



[agriculture.](https://en.wikipedia.org/wiki/Agriculture)[[4]](#page20) [Fishing](https://en.wikipedia.org/wiki/Fishing) in salt and fresh water bodies is a major source of food for many parts of the [world.](https://en.wikipedia.org/wiki/World) Much of long-distance trade of [commodities](https://en.wikipedia.org/wiki/Commodity) (such as oil and natural gas) and manufactured products is transported by [boats](https://en.wikipedia.org/wiki/Boats) through [seas,](https://en.wikipedia.org/wiki/Sea) [rivers,](https://en.wikipedia.org/wiki/River) [lakes,](https://en.wikipedia.org/wiki/Lake) and [canals.](https://en.wikipedia.org/wiki/Canal) Large quantities of water, [ice,](https://en.wikipedia.org/wiki/Ice) and [steam](https://en.wikipedia.org/wiki/Steam) are used for [cooling](https://en.wikipedia.org/wiki/Cooling) and [heating,](https://en.wikipedia.org/wiki/Heating) in [industry](https://en.wikipedia.org/wiki/Industry) and [homes.](https://en.wikipedia.org/wiki/Homes) Water is an excellent [solvent](https://en.wikipedia.org/wiki/Solvent) for a wide variety of [chemical](https://en.wikipedia.org/wiki/Chemical) substances; as such it is widely used in industrial processes, and in cooking and [washing. Water, ice and snow are also central to many sports and other forms of entertainment, such as swimming, pleasure](https://en.wikipedia.org/wiki/Pleasure_boat) [boating,](https://en.wikipedia.org/wiki/Pleasure_boat) [boat racing,](https://en.wikipedia.org/wiki/Boat_racing) [surfing,](https://en.wikipedia.org/wiki/Surfing) [sport fishing,](https://en.wikipedia.org/wiki/Sport_fishing) [diving,](https://en.wikipedia.org/wiki/Underwater_diving) [ice skating](https://en.wikipedia.org/wiki/Ice_skating) [and](https://en.wikipedia.org/wiki/Pleasure_boat) [skiing.](https://en.wikipedia.org/wiki/Skiing)



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**Etymology**

Stones are hollowed out by the



constant dropping of water. ~ [Ovid](https://en.wikipedia.org/wiki/Ovid)



The word *water* comes from [Old English](https://en.wikipedia.org/wiki/Old_English) *wæter*, from [Proto-Germanic](https://en.wikipedia.org/wiki/Proto-Germanic_language) \**watar* (source also of [Old Saxon](https://en.wikipedia.org/wiki/Old_Saxon) *watar*, [Old Frisian](https://en.wikipedia.org/wiki/Old_Frisian) *wetir*, [Dutch](https://en.wikipedia.org/wiki/Dutch_language) water, [Old High German](https://en.wikipedia.org/wiki/Old_High_German) wazzar, [German](https://en.wikipedia.org/wiki/German_language) Wasser, [Old Norse](https://en.wikipedia.org/wiki/Old_Norse) vatn, [Gothic](https://en.wikipedia.org/wiki/Gothic_language) wato), from [Proto-Indo-European](https://en.wikipedia.org/wiki/Proto-Indo-European_language) \*wod-



*or*, suffixed form of root \**wed-* ("water"; "wet").[[5]](#page20)Also[cognate,](https://en.wikipedia.org/wiki/Cognate) *through* the Indo-European root, with [Greek](https://en.wikipedia.org/wiki/Greek_language) ύδωρ (ýdor), [Russian](https://en.wikipedia.org/wiki/Russian_language) *вода́*(vodá), [Irish](https://en.wikipedia.org/wiki/Irish_language) *uisce*, [Albanian](https://en.wikipedia.org/wiki/Albanian_language) *ujë*.



**History**



[The identification of water as a substance](https://en.wikipedia.org/wiki/Properties_of_water" \l "History)



**Chemical and physical properties**



[Water (H2O) is a polar inorganic compound that is at room temperature a tasteless and odorless liquid, nearly colorless with a hint](https://en.wikipedia.org/wiki/Color_of_water) [of blue. This simplest](https://en.wikipedia.org/wiki/Color_of_water) [hydrogen chalcogenide](https://en.wikipedia.org/wiki/Hydrogen_chalcogenide) [is by far the most studied chemical compound and is described as the "universal](https://en.wikipedia.org/wiki/Color_of_water) solvent" for its ability to dissolve many substances.[[6][7]](#page20) This allows it to be the ["solvent](https://en.wikipedia.org/wiki/Solvent) of life".[[8]](#page20) It is the only common substance to exist as a [solid,](https://en.wikipedia.org/wiki/Ice) liquid, and [gas](https://en.wikipedia.org/wiki/Water_vapor) in normal terrestrial conditions.[[9]](#page20)

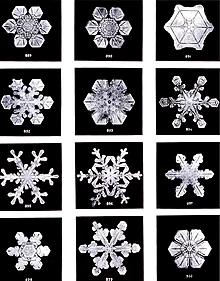


**States**

Liquid water, showing droplets and air bubbles caused by the drops



|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Water is a liquid at the |  |  | | | | | | | | |
| temperatures and pressures that |  |  | | | | | | | | |
| are most adequate for life. |  |  | | | | | | | | |
| Specifically, at | a standard |  |  | | | | | | | |
| pressure of 1 [atm,](https://en.wikipedia.org/wiki/Atmosphere_(unit)) water is a |  |  | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |  |
| liquid between 0 and 100 °C |  |  | | | | | | | | |
| (32 and 212 °F). Increasing the |  |  | | | | | | | | |
| pressure slightly | lowers the |  |  | | | | | | | |
| [melting point,](https://en.wikipedia.org/wiki/Melting_point) which is about |  |  | | | | | | | | |
|  |  |  |  |  |  |  |  |  | | |
| −5 °C (23 °F) at 600 atm and |  |  | | | | | | | | |
| −22 °C (−8 °F) at 2100 atm. |  |  | | | | | | | | |
| This effect is relevant, for |  |  | | | | | | | | |
| example, to [ice skating,](https://en.wikipedia.org/wiki/Ice_skating) to the |  |  | | | | | | | | |
|  |  |  |  |  |  |  |  | | | |
| [buried lakes of Antarctica,](https://en.wikipedia.org/wiki/Lake_Vostok) and | [*Snowflakes*](https://en.wikipedia.org/wiki/Snowflake) by[Wilson Bentley,](https://en.wikipedia.org/wiki/Wilson_Bentley) *1902* |  | | | | | | | | |
|  |  |  |  |  |  | | | | | |
| to the movement of [glaciers.](https://en.wikipedia.org/wiki/Glacier) At |  | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |  |



pressures higher than 2100 atm the melting point rapidly increases again, and ice takes several exotic forms that do not exist at lower pressures.

Increasing the pressure has a more dramatic effect on the [boiling point,](https://en.wikipedia.org/wiki/Boiling_point) that is about 374 °C (705 °F) at 220 atm. This effect is important in, among other things, deep-sea [hydrothermal vents](https://en.wikipedia.org/wiki/Hydrothermal_vents) and [geysers,](https://en.wikipedia.org/wiki/Geyser) [pressure cooking,](https://en.wikipedia.org/wiki/Pressure_cooking) and [steam engine](https://en.wikipedia.org/wiki/Steam_engine) design. At the top of [Mount Everest,](https://en.wikipedia.org/wiki/Mount_Everest) where the atmospheric pressure is about 0.34 atm, water boils at 68 °C (154 °F).



At very low pressures (below about 0.006 atm), water cannot exist in the liquid state and passes directly from solid to gas by [sublimation—a](https://en.wikipedia.org/wiki/Sublimation_(phase_transition)) phenomenon exploited in the [freeze drying](https://en.wikipedia.org/wiki/Freeze_drying) of food. At very high pressures (above 221 atm), the liquid and gas states are no longer distinguishable, a state called [supercritical steam.](https://en.wikipedia.org/wiki/Supercritical_fluid)



Water also differs from most liquids in that it becomes less [dense](https://en.wikipedia.org/wiki/Density) as it freezes. The maximum density of water in its liquid form (at 1 atm) is 1,000 kg/m3 (62.43 lb/cu ft); that occurs at 3.98 °C (39.16 °F).[[10]](#page20) The density of ice is 917 kg/m3 (57.25 lb/cu ft).[[11][12]](#page21) Thus, water expands 9% in volume as it freezes, which accounts for the fact that ice floats on liquid water.



The details of the exact chemical nature of liquid water are not well understood; some theories suggest that the unusual behaviour of water is due to the existence of 2 liquid states.[[10][13][14][15]](#page21)

**Taste and odor**

Pure water is usually described as tasteless and odorless, although humans have specific sensors that can feel the presence of water in their mouths,[[16]](#page21) and frogs are known to be able to smell it.[[17]](#page21) However, water from ordinary sources (including bottled mineral water) usually has many dissolved substances, that may give it varying tastes and odors. [Humans](https://en.wikipedia.org/wiki/Humans) and other animals have



developed senses that enable them to evaluate the [potability](https://en.wikipedia.org/wiki/Drinking_water) of water by avoiding water that is too salty or [putrid.](https://en.wikipedia.org/wiki/Putrid)[[18]](#page21)



**Color and appearance**

The apparent color of natural bodies of water (and swimming pools) is often determined more by dissolved and suspended solids, or by reflection of the sky, than by water itself.

Light in the visible [electromagnetic spectrum](https://en.wikipedia.org/wiki/Electromagnetic_spectrum) can traverse a couple meters of pure water (or ice) without significant [absorption,](https://en.wikipedia.org/wiki/Optical_absorption)



so that it looks [transparent](https://en.wikipedia.org/wiki/Transparency_(optics)) and colorless.[[19]](#page21) Thus [aquatic plants,](https://en.wikipedia.org/wiki/Aquatic_plant) [algae,](https://en.wikipedia.org/wiki/Alga) and other [photosynthetic](https://en.wikipedia.org/wiki/Photosynthesis) organisms can live in water up to hundreds of meters deep, because [sunlight](https://en.wikipedia.org/wiki/Sunlight) can reach them. Water vapour is essentially invisible as a gas.



Through a thickness of 10 meters (33 ft) or more, however, the intrinsic [color of water](https://en.wikipedia.org/wiki/Color_of_water) (or ice) is visibly turquoise (greenish-



blue). Its [absorption spectrum](https://en.wikipedia.org/wiki/Electromagnetic_absorption_by_water) has a sharp minimum at a violet-blue color of light (1/227 m−1 at 418 nm). The lower, but still significant, absorption of longer wavelengths makes the perceived colour to be nearer to a turquoise shade. The color becomes increasingly stronger and darker with increasing thickness. (Practically no sunlight reaches the parts of the oceans below 1,000 meters (3,300 ft) of depth.) Infrared and ultraviolet light, on the other hand, is strongly [absorbed](https://en.wikipedia.org/wiki/Absorption_(electromagnetic_radiation)) by water.

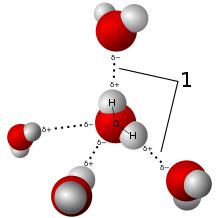


The [refraction index](https://en.wikipedia.org/wiki/Refraction_index) of liquid water (1.333 at 20 °C (68 °F)) is much higher than that of air (1.0), similar to those of [alkanes](https://en.wikipedia.org/wiki/Alkane) and [ethanol,](https://en.wikipedia.org/wiki/Ethanol) but lower than those of [glycerol](https://en.wikipedia.org/wiki/Glycerol) (1.473), [benzene](https://en.wikipedia.org/wiki/Benzene) (1.501), [carbon disulfide](https://en.wikipedia.org/wiki/Carbon_disulfide) (1.627), and common types of glass (1.4 to 1.6). The refraction index of ice (1.31) is lower than that of liquid water.



**Polarity and hydrogen bonding**

Model of [hydrogen bonds](https://en.wikipedia.org/wiki/Hydrogen_bond) (1) between molecules of water.



Since the water molecule is not linear and the oxygen atom has a higher [electronegativity than hydrogen atoms, it is a polar molecule, with an electrical](https://en.wikipedia.org/wiki/Electrical_dipole_moment) [dipole moment: the oxygen atom carries a slight negative charge, whereas the](https://en.wikipedia.org/wiki/Electrical_dipole_moment) hydrogen atoms are slightly positive. Water is a good polar [solvent,](https://en.wikipedia.org/wiki/Solvent) that dissolves many [salts](https://en.wikipedia.org/wiki/Salt_(chemistry)) and [hydrophilic](https://en.wikipedia.org/wiki/Hydrophilic) organic molecules such as sugars and simple alcohols such as [ethanol.](https://en.wikipedia.org/wiki/Ethanol) Water also dissolves many gases, such as oxygen and [carbon](https://en.wikipedia.org/wiki/Carbon_dioxide) dioxide—the latter giving the fizz of [carbonated](https://en.wikipedia.org/wiki/Carbonation) beverages, [sparkling wines](https://en.wikipedia.org/wiki/Sparkling_wine) and beers. In addition, many substances in living organisms, such as [proteins,](https://en.wikipedia.org/wiki/Protein) [DNA](https://en.wikipedia.org/wiki/DNA) and [polysaccharides,](https://en.wikipedia.org/wiki/Polysaccharide) are dissolved in water. The interactions between water and the subunits of these biomacromolecules shape [protein folding,](https://en.wikipedia.org/wiki/Protein_folding) [DNA base pairing,](https://en.wikipedia.org/wiki/Base_pairing) and other phenomena crucial to life [(hydrophobic effect)](https://en.wikipedia.org/wiki/Hydrophobic_effect).



Many organic substances (such as [fats and oils](https://en.wikipedia.org/wiki/Lipids) and [alkanes)](https://en.wikipedia.org/wiki/Alkanes) are [hydrophobic,](https://en.wikipedia.org/wiki/Hydrophobic) that is, insoluble in water. Many inorganic substances are insoluble too,



including most metal [oxides,](https://en.wikipedia.org/wiki/Oxide) [sulfides,](https://en.wikipedia.org/wiki/Sulfide) and [silicates.](https://en.wikipedia.org/wiki/Silicate)



Because of its polarity, a molecule of water in the liquid or solid state can form up to four [hydrogen bonds](https://en.wikipedia.org/wiki/Hydrogen_bonds) with neighboring



molecules. These bonds are the cause of water's high [surface tension](https://en.wikipedia.org/wiki/Surface_tension)[[20]](#page21) and capillary forces. The [capillary action](https://en.wikipedia.org/wiki/Capillary_action) refers to the tendency of water to move up a narrow tube against the force of [gravity.](https://en.wikipedia.org/wiki/Gravity) This property is relied upon by all [vascular plants,](https://en.wikipedia.org/wiki/Vascular_plant) such as trees.[[21]](#page21)



[The hydrogen bonds are also the reason why the melting and boiling points of water are much higher than those of other](https://en.wikipedia.org/wiki/Hydrogen_chalcogenide) [analogous compounds like](https://en.wikipedia.org/wiki/Hydrogen_chalcogenide) [hydrogen sulfide](https://en.wikipedia.org/wiki/Hydrogen_sulfide) [(H](https://en.wikipedia.org/wiki/Hydrogen_chalcogenide)2S). They also explain its exceptionally high [specific heat capacity](https://en.wikipedia.org/wiki/Specific_heat_capacity) [(about 4.2](https://en.wikipedia.org/wiki/Hydrogen_chalcogenide) [J/g/K),](https://en.wikipedia.org/wiki/Joule) [heat of fusion](https://en.wikipedia.org/wiki/Heat_of_fusion) (about 333 J/g), [heat of vaporization](https://en.wikipedia.org/wiki/Heat_of_vaporization) (2257 J/g), and [thermal conductivity](https://en.wikipedia.org/wiki/Thermal_conductivity) (between 0.561 and 0.679 W/m/K). These properties make water more effective at moderating Earth's [climate,](https://en.wikipedia.org/wiki/Climate) by storing heat and transporting it between the oceans and the atmosphere. The hydrogen bonds of water are of moderate strength, around 23 kJ/mol (compared to a covalent O-H bond at 492 kJ/mol). Of this, it is estimated that 90% of the hydrogen bond is attributable to electrostatics, while the remaining 10% reflects partial covalent character.[[22]](#page21)



**Electrical conductivity and electrolysis**

Pure water has a low [electrical conductivity,](https://en.wikipedia.org/wiki/Electrical_conductivity) which increases with the [dissolution](https://en.wikipedia.org/wiki/Dissolution_(chemistry)) of a small amount of ionic material such as [common salt.](https://en.wikipedia.org/wiki/Sodium_chloride)



Liquid water can be split into the [elements](https://en.wikipedia.org/wiki/Chemical_element) hydrogen and oxygen by passing an electric current through it—a process called [electrolysis.](https://en.wikipedia.org/wiki/Electrolysis_of_water) The decomposition requires more energy input than the [heat released by the inverse process](https://en.wikipedia.org/wiki/Standard_enthalpy_of_formation) (285.8 [kJ/mol,](https://en.wikipedia.org/wiki/Mole_(unit)) or 15.9



MJ/kg).[[23]](#page21)

**Mechanical properties**

Liquid water can be assumed to be incompressible for most purposes: its compressibility ranges from 4.4 to 5.1 × 10−10 Pa−1 in ordinary conditions.[[24]](#page22) Even in oceans at 4 km depth, where the pressure is 400 atm, water suffers only a 1.8% decrease in volume.[[25]](#page22)

The [viscosity](https://en.wikipedia.org/wiki/Viscosity) of water is about 10−3 [Pa·s](https://en.wikipedia.org/wiki/Second) or 0.01 [poise](https://en.wikipedia.org/wiki/Poise_(unit)) at 20 °C (68 °F), and the [speed of sound](https://en.wikipedia.org/wiki/Speed_of_sound) in liquid water ranges between 1,400 and 1,540 meters per second (4,600 and 5,100 ft/s) depending on temperature. Sound travels long distances in water with little attenuation, especially at low frequencies (roughly 0.03 [dB/km](https://en.wikipedia.org/wiki/Decibel) for 1 [kHz),](https://en.wikipedia.org/wiki/Hertz) a property that is exploited by [cetaceans](https://en.wikipedia.org/wiki/Cetaceans) and



humans for communication and environment sensing [(sonar)](https://en.wikipedia.org/wiki/Sonar).[[26]](#page22)



**Reactivity**

Metallic elements which are more [electropositive](https://en.wikipedia.org/wiki/Electropositivity) than hydrogen such as [lithium,](https://en.wikipedia.org/wiki/Lithium) [sodium,](https://en.wikipedia.org/wiki/Sodium) [calcium,](https://en.wikipedia.org/wiki/Calcium) [potassium](https://en.wikipedia.org/wiki/Potassium) and [caesium](https://en.wikipedia.org/wiki/Caesium) displace hydrogen from water, forming [hydroxides](https://en.wikipedia.org/wiki/Hydroxide) and releasing hydrogen. At high temperatures, carbon reacts with steam to form [carbon monoxide.](https://en.wikipedia.org/wiki/Carbon_monoxide)



**On Earth**



Hydrology is the study of the movement, distribution, and quality of water throughout the Earth. The study of the distribution of water is [hydrography.](https://en.wikipedia.org/wiki/Hydrography) The study of the distribution and movement of groundwater is [hydrogeology,](https://en.wikipedia.org/wiki/Hydrogeology) of glaciers is [glaciology,](https://en.wikipedia.org/wiki/Glaciology) of inland waters is [limnology](https://en.wikipedia.org/wiki/Limnology) and distribution of oceans is [oceanography.](https://en.wikipedia.org/wiki/Oceanography) Ecological processes with hydrology are in focus of [ecohydrology.](https://en.wikipedia.org/wiki/Ecohydrology)



The collective mass of water found on, under, and over the surface of a planet is called the [hydrosphere.](https://en.wikipedia.org/wiki/Hydrosphere) Earth's approximate water volume (the total water supply



of the world) is 1.338 billion cubic kilometers (321 ×106 cu mi).[[2]](#page20)

Liquid water is found in [bodies of water,](https://en.wikipedia.org/wiki/Body_of_water) such as an ocean, sea, lake, river, stream, [canal,](https://en.wikipedia.org/wiki/Canal) pond, or [puddle.](https://en.wikipedia.org/wiki/Puddle) The majority of water on Earth is [sea water.](https://en.wikipedia.org/wiki/Sea_water) Water is also present in the atmosphere in solid, liquid, and vapor states. It also exists as groundwater in [aquifers.](https://en.wikipedia.org/wiki/Aquifer)



Water is important in many geological processes. Groundwater is present in most [rocks,](https://en.wikipedia.org/wiki/Rock_(geology)) and the pressure of this groundwater affects patterns of [faulting.](https://en.wikipedia.org/wiki/Fault_(geology)) Water in [the mantle is responsible for the melt that produces volcanoes at subduction](https://en.wikipedia.org/wiki/Subduction_zone) [zones. On the surface of the Earth, water is important in both chemical and](https://en.wikipedia.org/wiki/Subduction_zone)



Water covers 71% of the Earth's surface; the oceans contain 96.5% of [the Earth's water. The Antarctic ice](https://en.wikipedia.org/wiki/Antarctic_ice_sheet) [sheet, which contains 61% of all](https://en.wikipedia.org/wiki/Antarctic_ice_sheet) fresh water on Earth, is visible at the bottom. Condensed atmospheric water can be seen as clouds, contributing to the Earth's [albedo.](https://en.wikipedia.org/wiki/Albedo)

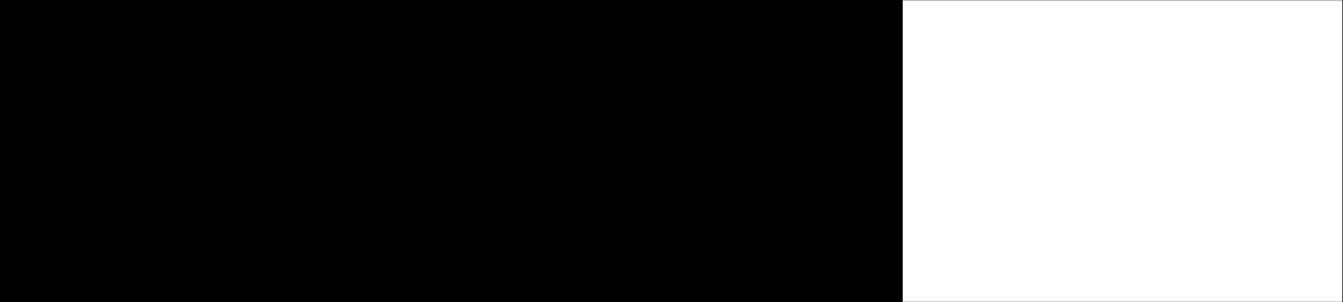


physical [weathering](https://en.wikipedia.org/wiki/Weathering) processes. Water, and to a lesser but still significant extent, ice, are also responsible for a large amount of [sediment transport that occurs on the surface of the earth. Deposition of transported sediment forms many types of sedimentary](https://en.wikipedia.org/wiki/Sedimentary_rock) [rocks, which make up the](https://en.wikipedia.org/wiki/Sedimentary_rock) [geologic record](https://en.wikipedia.org/wiki/Geologic_record) [of](https://en.wikipedia.org/wiki/Sedimentary_rock) [Earth history.](https://en.wikipedia.org/wiki/History_of_the_Earth)



**Water cycle**

The [water cycle](https://en.wikipedia.org/wiki/Water_cycle) (known scientifically as the hydrologic cycle) refers to the continuous exchange of water within the [hydrosphere,](https://en.wikipedia.org/wiki/Hydrosphere) between the [atmosphere,](https://en.wikipedia.org/wiki/Earth_atmosphere) [soil](https://en.wikipedia.org/wiki/Soil) water, [surface water,](https://en.wikipedia.org/wiki/Surface_water) [groundwater,](https://en.wikipedia.org/wiki/Groundwater) and plants.



Water moves perpetually through each of these regions in the *water cycle* consisting of the following transfer processes:

[evaporation](https://en.wikipedia.org/wiki/Evaporation) from oceans and other water bodies into the air and [transpiration](https://en.wikipedia.org/wiki/Transpiration) from land plants and animals into the air.



[precipitation,](https://en.wikipedia.org/wiki/Precipitation_(meteorology)) from water vapor condensing from the air and falling to Water cycle the earth or ocean.



[runoff](https://en.wikipedia.org/wiki/Runoff_(water)) from the land usually reaching the sea.



Most water vapor over the oceans returns to the oceans, but winds carry water vapor over land at the same rate as runoff into the sea, about 47 [Tt](https://en.wikipedia.org/wiki/Metric_tonne_unit) per year. Over land, evaporation and transpiration contribute another 72 Tt per year. Precipitation, at a rate of 119



Tt per year over land, has several forms: most commonly rain, snow, and [hail,](https://en.wikipedia.org/wiki/Hail) with some contribution from [fog](https://en.wikipedia.org/wiki/Fog) and [dew.](https://en.wikipedia.org/wiki/Dew)[[27]](#page22) Dew is small drops of water that are condensed when a high density of water vapor meets a cool surface. Dew usually forms in the morning when the temperature is the lowest, just before sunrise and when the temperature of the earth's surface starts to increase.[[28]](#page22) Condensed water in the air may also [refract](https://en.wikipedia.org/wiki/Refract) [sunlight](https://en.wikipedia.org/wiki/Sunlight) to produce [rainbows.](https://en.wikipedia.org/wiki/Rainbow)



Water runoff often collects over [watersheds](https://en.wikipedia.org/wiki/Drainage_basin) flowing into rivers. A mathematical model used to simulate river or stream flow and calculate water quality parameters is a [hydrological transport model.](https://en.wikipedia.org/wiki/Hydrological_transport_model) Some water is diverted to [irrigation](https://en.wikipedia.org/wiki/Irrigation) for agriculture. Rivers and seas offer opportunity for travel and commerce. Through [erosion,](https://en.wikipedia.org/wiki/Erosion) runoff shapes the environment creating river [valleys](https://en.wikipedia.org/wiki/Valley) and [deltas](https://en.wikipedia.org/wiki/River_delta) which provide rich soil and level ground for the establishment of population centers. A flood occurs when an area of land, usually low-lying, is covered with water. It is when a river overflows its banks or flood comes from the sea. A drought is an extended period of months or years when a region notes a deficiency in its water supply. This occurs when a region receives consistently below average precipitation.



**Fresh water storage**

Water occurs as both "stocks" and "flows." Water can be stored as lakes, water vapor, groundwater or "aquifers," and ice and snow. Of the total volume of global freshwater, an estimated 69 percent is stored in glaciers and permanent snow cover; 30 percent is in groundwater; and the remaining 1 percent in lakes, rivers, the atmosphere, and biota.[[29]](#page22) The length of time water remains in storage is highly variable: some aquifers consist of water stored over thousands of years but lake volumes may fluctuate on a seasonal basis, decreasing during dry periods and increasing during wet ones. A substantial fraction of the water supply for some regions consists of water extracted from water stored in stocks, and when withdrawals exceed recharge, stocks decrease. By some estimates, as much as 30 percent of total water used for irrigation comes from unsustainable withdrawals of groundwater, causing groundwater depletion.[[30]](#page22)

**Sea water and tides**

[Sea water](https://en.wikipedia.org/wiki/Seawater) contains about 3.5% [sodium chloride](https://en.wikipedia.org/wiki/Sodium_chloride) on average, plus smaller amounts of other substances. The physical properties of sea water differ from fresh water in some important respects. It freezes at a lower temperature (about −1.9 °C (28.6 °F)) and its density increases with decreasing temperature to the freezing point, instead of reaching maximum density at a temperature above





The [Bay of Fundy](https://en.wikipedia.org/wiki/Bay_of_Fundy) at high tide and low tide. At low tide, many rocks are exposed and the boat in the picture is grounded.

freezing. The salinity of water in major seas varies from about 0.7% in the [Baltic Sea](https://en.wikipedia.org/wiki/Baltic_Sea) to 4.0% in the [Red Sea.](https://en.wikipedia.org/wiki/Red_Sea) (The [Dead Sea,](https://en.wikipedia.org/wiki/Dead_Sea) known for its ultra-high salinity levels of between 30–40%, is really a [salt lake.)](https://en.wikipedia.org/wiki/Salt_lake)



[Tides](https://en.wikipedia.org/wiki/Tide) are the cyclic rising and falling of local sea levels caused by the [tidal forces](https://en.wikipedia.org/wiki/Tidal_force) of the Moon and the Sun acting on the oceans. Tides cause changes in the depth of the marine and [estuarine](https://en.wikipedia.org/wiki/Estuary) water bodies and produce oscillating currents known as tidal streams. The changing tide produced at a given location is the result of the changing positions of the Moon and Sun relative to the Earth coupled with the [effects of Earth rotation](https://en.wikipedia.org/wiki/Coriolis_effect) and the local [bathymetry.](https://en.wikipedia.org/wiki/Bathymetry) The strip of seashore that is submerged at high tide and exposed at low tide, the [intertidal zone,](https://en.wikipedia.org/wiki/Intertidal_zone) is an important ecological product of ocean tides.



**Effects on life**



An [oasis](https://en.wikipedia.org/wiki/Oasis) is an isolated [water source](https://en.wikipedia.org/wiki/Water_source) with vegetation in a [desert.](https://en.wikipedia.org/wiki/Desert)



From a [biological](https://en.wikipedia.org/wiki/Biology) standpoint, water has many distinct properties that are critical [for the proliferation of life. It carries out this role by allowing organic](https://en.wikipedia.org/wiki/Organic_compound) [compounds to react in ways that ultimately allow](https://en.wikipedia.org/wiki/Organic_compound) [replication.](https://en.wikipedia.org/wiki/Self-replication) [All known forms](https://en.wikipedia.org/wiki/Organic_compound) of life depend on water. Water is vital both as a [solvent](https://en.wikipedia.org/wiki/Solvent) in which many of the body's solutes dissolve and as an essential part of many [metabolic](https://en.wikipedia.org/wiki/Metabolism) processes within the body. Metabolism is the sum total of [anabolism](https://en.wikipedia.org/wiki/Anabolism) and [catabolism.](https://en.wikipedia.org/wiki/Catabolism) In anabolism, water is removed from molecules (through energy requiring enzymatic chemical reactions) in order to grow larger molecules (e.g. starches, triglycerides and proteins for storage of fuels and information). In catabolism, water is used to break bonds in order to generate smaller molecules (e.g. glucose, fatty acids and amino acids to be used for fuels for energy use or other purposes). Without water, these particular metabolic processes could not exist.



Water is fundamental to photosynthesis and respiration. Photosynthetic cells use the sun's energy to split off water's hydrogen from oxygen. Hydrogen is combined with CO2 (absorbed from air or water) to form glucose and release oxygen. All living cells use such fuels and oxidize the hydrogen and carbon to capture the sun's energy and reform water and CO2 in the process (cellular respiration).

Water is also central to acid-base neutrality and enzyme function. An acid, a hydrogen ion (H+, that is, a proton) donor, can be neutralized by a base, a proton acceptor such as a hydroxide ion (OH−) to form water. Water is considered to be neutral, with a [pH](https://en.wikipedia.org/wiki/PH) (the negative log of the hydrogen ion concentration) of 7. [Acids](https://en.wikipedia.org/wiki/Acids) have pH values less than 7 while [bases](https://en.wikipedia.org/wiki/Base_(chemistry)) have values greater than 7.

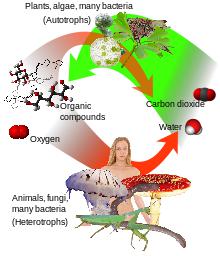


**Aquatic life forms**

Earth surface waters are filled with life. The earliest life forms appeared in water; nearly all fish live exclusively in water, and there are many types of marine mammals, such as dolphins and whales. Some kinds of animals, such as [amphibians,](https://en.wikipedia.org/wiki/Amphibian) spend portions of their lives in water and portions on land. Plants such as [kelp](https://en.wikipedia.org/wiki/Kelp) and [algae](https://en.wikipedia.org/wiki/Algae) grow in the water and are the basis for some underwater ecosystems. [Plankton](https://en.wikipedia.org/wiki/Plankton) is generally the foundation of the ocean [food chain.](https://en.wikipedia.org/wiki/Food_chain)



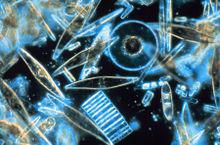
Overview of [photosynthesis (green)](https://en.wikipedia.org/wiki/Photosynthesis) and [respiration (red)](https://en.wikipedia.org/wiki/Cellular_respiration). Water (at right), together with carbon dioxide (CO2), form oxygen and organic compounds (at left), which can be respired to water and (CO2).



Aquatic vertebrates must obtain oxygen to survive, and they do so in various ways. Fish have [gills](https://en.wikipedia.org/wiki/Gills) instead of [lungs,](https://en.wikipedia.org/wiki/Lungs) although some species of fish, such as the [lungfish,](https://en.wikipedia.org/wiki/Lungfish) have both. [Marine mammals,](https://en.wikipedia.org/wiki/Marine_mammal) such as dolphins, whales, [otters,](https://en.wikipedia.org/wiki/Otter) and [seals](https://en.wikipedia.org/wiki/Pinniped) need to surface periodically to breathe air. Some amphibians are able to absorb oxygen through their skin. Invertebrates exhibit a wide range of modifications to survive in poorly oxygenated waters including breathing tubes (see [insect](https://en.wikipedia.org/wiki/Siphon_(insect)) and [mollusc siphons)](https://en.wikipedia.org/wiki/Siphon_(mollusc)) and [gills](https://en.wikipedia.org/wiki/Gills) ([*Carcinus*](https://en.wikipedia.org/wiki/Carcinus)). However as invertebrate life evolved in an aquatic habitat most have little or no specialisation for respiration in water.



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| **Effects on human civilization** | | | | | | | | | | | | | | | | | | | | | | | Some of the [biodiversity](https://en.wikipedia.org/wiki/Biodiversity) of a | | |
| Civilization has historically flourished around rivers and major waterways; [Mesopotamia,](https://en.wikipedia.org/wiki/Mesopotamia) | | | | | | | | | | | | | | | | | | | | | | | [coral reef](https://en.wikipedia.org/wiki/Coral_reef) | | |
|  |  |  |  |  |  |  |  |  |  | | |  | |  |  | | |  | |  | |  | | |  |
| the so-called cradle of civilization, was situated between the major rivers [Tigris](https://en.wikipedia.org/wiki/Tigris) and | | | | | | | | | | | | | | | | | | | | | | |  | | |
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| [Euphrates;](https://en.wikipedia.org/wiki/Euphrates) the ancient society of the [Egyptians](https://en.wikipedia.org/wiki/Egyptians) depended entirely upon the [Nile.](https://en.wikipedia.org/wiki/Nile) | | | | | | | | | | | | | | | | | | | | | | |  | | |
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| Rome was also founded on the banks of the Italian river [Tiber.](https://en.wikipedia.org/wiki/Tiber) Large | | | | | | | | | | | | | | | | | | | | | | |  | | |
|  |  | |  |  |  | | |  |  | | |  | | | | |  | | | | | | |  | |
| [metropolises like Rotterdam, London, Montreal, Paris, New York City, Buenos](https://en.wikipedia.org/wiki/Buenos_Aires) | | | | | | | | | | | | | | | | | | | | | | |  | | |
|  |  | |  |  |  | | | | |  | | | | | |  | | | | | | |  | | |
| [Aires, Shanghai, Tokyo, Chicago, and Hong Kong owe their success in part to](https://en.wikipedia.org/wiki/Buenos_Aires) | | | | | | | | | | | | | | | | | | | | | | |  | | |
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| their easy accessibility via water and the resultant expansion of trade. Islands | | | | | | | | | | | | | | | | | | | | | | |  | | |
| with safe water ports, like Singapore, have flourished for the same reason. In | | | | | | | | | | | | | | | | | | | | | | |  | | |
| places such as North Africa and the Middle East, where water is more scarce, | | | | | | | | | | | | | | | | | | | | | | |  | | |



access to clean drinking water was and is a major factor in human development.

Some marine [diatoms](https://en.wikipedia.org/wiki/Diatom) – a key

[phytoplankton](https://en.wikipedia.org/wiki/Phytoplankton) group

**Health and pollution**

Water fit for human consumption is called [drinking water](https://en.wikipedia.org/wiki/Drinking_water) or potable water. Water that is not potable may be made potable by filtration or [distillation,](https://en.wikipedia.org/wiki/Distillation) or by a range of [other methods.](https://en.wikipedia.org/wiki/Water_treatment)



Water that is not fit for drinking but is not harmful for humans when used for swimming or bathing is called by various names other than potable or drinking water, and is sometimes called [safe water,](https://en.wikipedia.org/wiki/Safe_water) or "safe for bathing". Chlorine is a skin and mucous membrane irritant that is used to make water safe for bathing or drinking. Its use is highly technical and is usually monitored by government regulations (typically 1 part per million (ppm) for drinking water, and 1–2 ppm of chlorine not yet reacted with impurities for bathing water). Water for bathing may be maintained in satisfactory microbiological condition using chemical disinfectants such as [chlorine](https://en.wikipedia.org/wiki/Chlorine) or [ozone](https://en.wikipedia.org/wiki/Ozone) or by the use of [ultraviolet](https://en.wikipedia.org/wiki/Ultraviolet) light.



In the US, non-potable forms of [wastewater](https://en.wikipedia.org/wiki/Wastewater) generated by humans may be referred to as [greywater,](https://en.wikipedia.org/wiki/Greywater) which is treatable and thus easily able to be made potable again, and [blackwater,](https://en.wikipedia.org/wiki/Blackwater_(waste)) which generally contains [sewage](https://en.wikipedia.org/wiki/Sewage) and other forms of waste which require [further treatment](https://en.wikipedia.org/wiki/Sewage_treatment) in order to be made reusable. Greywater composes 50–80% of residential wastewater generated by a household's sanitation equipment [(sinks,](https://en.wikipedia.org/wiki/Sink) showers and kitchen runoff, but not toilets, which generate blackwater.) These terms may have different meanings in other countries and cultures.

An environmental science program – a student from [Iowa State University](https://en.wikipedia.org/wiki/Iowa_State_University) sampling water

Water [fountain](https://en.wikipedia.org/wiki/Fountain)



This natural resource is becoming scarcer in certain places, and its availability is a major social and economic concern. Currently, about a billion people around the world routinely drink unhealthy water. In 2000, the [United Nations](https://en.wikipedia.org/wiki/United_Nations) established the [Millennium Development Goals](https://en.wikipedia.org/wiki/Millennium_Development_Goals) for water to halve by 2015 the proportion of people worldwide without access to safe water and [sanitation.](https://en.wikipedia.org/wiki/Sanitation) Progress toward that goal was uneven, and in 2015 the UN committed to the



following targets set by the [Sustainable Development Goals](https://en.wikipedia.org/wiki/Sustainable_Development_Goals) of achieving universal access to safe and affordable water and sanitation by 2030. Poor [water quality](https://en.wikipedia.org/wiki/Water_quality) and bad sanitation are deadly; some five million deaths a year are caused by water-related diseases. The [World Health Organization](https://en.wikipedia.org/wiki/World_Health_Organization) estimates that [safe water](https://en.wikipedia.org/wiki/Safe_water) could prevent 1.4 million child deaths from [diarrhea](https://en.wikipedia.org/wiki/Diarrhea) each year.[[31]](#page22)



Water, however, is not an infinite resource (meaning the availability of water is limited), but rather re-circulated as potable water in precipitation[[32]](#page22) in quantities many orders of magnitude higher than human consumption. Therefore, it is the relatively small quantity of water in reserve in the earth (about 1% of our drinking [water supply,](https://en.wikipedia.org/wiki/Water_supply) which is replenished in aquifers around every 1 to 10 years), that is a [non-renewable resource,](https://en.wikipedia.org/wiki/Non-renewable_resource) and it is, rather, the distribution of potable and irrigation water which is scarce, rather than the actual amount of it that exists on the earth. Water-poor countries use importation of goods as the primary method of importing water (to leave enough for local human consumption), since the manufacturing process uses around 10 to 100 times products' masses in water.



In the developing world, 90% of all [wastewater](https://en.wikipedia.org/wiki/Wastewater) still goes untreated into local rivers and streams.[[33]](#page22) Some 50 countries, with roughly a third of the world's population, also suffer from medium or high water stress, and 17 of these extract more water annually than is recharged through their natural water cycles.[[34]](#page22) The strain not only affects surface freshwater bodies like rivers and lakes, but it also degrades groundwater resources.



**Human uses**

**Agriculture**

The most important use of water in agriculture is for [irrigation,](https://en.wikipedia.org/wiki/Irrigation) which is a key component to produce enough food. Irrigation takes up to 90% of water withdrawn in some developing countries[[35]](#page22) and significant proportions in more economically developed countries (in the United States, 42% of freshwater withdrawn for use is for irrigation).[[36]](#page22)



Fifty years ago, the common perception was that water was an infinite resource. At the time, there were fewer than half the current number of people on the planet. People were not as wealthy as today, consumed fewer calories and ate less meat, so less water was needed to produce their food. They required a third of the volume of water we presently take from rivers. Today, the competition for the fixed amount of water resources is much more intense, giving rise to the concept of [peak water.](https://en.wikipedia.org/wiki/Peak_water)[[37]](#page22) This is because there are now nearly seven billion people on the planet, their consumption of water-thirsty meat and vegetables is rising, and there is increasing competition for water from industry, urbanisation and biofuel crops. In future, even more water will be needed to produce food because the Earth's population is forecast to rise to 9 billion by 2050.[[38]](#page22)

[Irrigation](https://en.wikipedia.org/wiki/Irrigation) of field crops

[Play media](https://upload.wikimedia.org/wikipedia/commons/b/b1/Subsurface_drip_emission_on_loamy_soil.ogv)

[Water distribution in subsurface drip](https://en.wikipedia.org/wiki/Drip_irrigation) [irrigation](https://en.wikipedia.org/wiki/Drip_irrigation)



An assessment of water management in agriculture was conducted in 2007 by the [International Water Management Institute](https://en.wikipedia.org/wiki/International_Water_Management_Institute) in Sri Lanka to see if the world



had sufficient water to provide food for its growing population.[[39]](#page22) It assessed the current availability of water for agriculture on a global scale and mapped out locations suffering from water scarcity. It found that a fifth of the world's people, more than 1.2 billion, live in areas of [physical water scarcity,](https://en.wikipedia.org/wiki/Physical_water_scarcity) where there is not



enough water to meet all demands. A further 1.6 billion people live in areas experiencing [economic water scarcity,](https://en.wikipedia.org/wiki/Economic_water_scarcity) where the lack of investment in water or insufficient human capacity make it impossible for authorities to satisfy the demand for water. The report found that it would be possible to produce the food required in future, but that continuation of today's food production and environmental trends would lead to crises in many parts of the world. To avoid a global water crisis, farmers will have to strive to increase productivity to meet growing demands for food, while industry and cities find ways to use water more efficiently.[[40]](#page23)



Water scarcity is also caused by production of [cotton:](https://en.wikipedia.org/wiki/Cotton) 1 kg of cotton—equivalent of a pair of jeans—requires 10.9 cubic meters (380 cu ft) water to produce. While cotton accounts for 2.4% of world water use, the water is consumed in regions which are already at a risk of water shortage. Significant environmental damage has been caused, such as disappearance of the [Aral Sea.](https://en.wikipedia.org/wiki/Aral_Sea)[[41]](#page23)



**As a scientific standard**

On 7 April 1795, the gram was defined in France to be equal to "the absolute weight of a volume of pure water equal to a cube of one hundredth of a meter, and at the temperature of melting ice".[[42]](#page23) For practical purposes though, a metallic reference standard was required, one thousand times more massive, the kilogram. Work was therefore commissioned to determine precisely the mass of one liter of water. In spite of the fact that the decreed definition of the gram specified water at 0 °C (32 °F)—a highly reproducible *temperature*—the scientists chose to redefine the standard and to perform their measurements at the temperature of highest water *density*, which was measured at the time as 4 °C (39 °F).[[43]](#page23)

The [Kelvin temperature scale](https://en.wikipedia.org/wiki/Kelvin_temperature_scale) of the [SI](https://en.wikipedia.org/wiki/International_System_of_Units) system was based on the [triple point](https://en.wikipedia.org/wiki/Triple_point) of water, defined as exactly 273.16 K (0.01 °C; 32.02 °F), but as of May 2019 is based on the [Boltzmann constant](https://en.wikipedia.org/wiki/Boltzmann_constant) instead. The scale is an [absolute temperature](https://en.wikipedia.org/wiki/Absolute_temperature) scale with the same increment as the Celsius temperature scale, which was originally defined according to the [boiling point](https://en.wikipedia.org/wiki/Boiling_point) (set to 100 °C (212 °F)) and [melting point](https://en.wikipedia.org/wiki/Melting_point) (set to 0 °C (32 °F)) of water.

Natural water consists mainly of the isotopes hydrogen-1 and oxygen-16, but there is also a small quantity of heavier isotopes oxygen-18, oxygen-17, and hydrogen-2 [(deuterium)](https://en.wikipedia.org/wiki/Deuterium). The percentage of the heavier isotopes is very small, but it still affects the properties of water. Water from rivers and lakes tends to contain less heavy isotopes than seawater. Therefore, standard water is defined in the [Vienna Standard Mean Ocean Water](https://en.wikipedia.org/wiki/Vienna_Standard_Mean_Ocean_Water) specification.



**For drinking**

[Hazard symbol](https://en.wikipedia.org/wiki/Hazard_symbol) for non-potable water

A young girl drinking [bottled water](https://en.wikipedia.org/wiki/Bottled_water)

Water availability: fraction of population using improved water sources by country

The [human body](https://en.wikipedia.org/wiki/Human_body) contains from 55% to 78% water, depending on body size.[[44]](#page23) To function properly, the body requires between one and seven liters (0.22 and 1.54 imp gal; 0.26 and 1.85 U.S. gal) of water per day to avoid [dehydration;](https://en.wikipedia.org/wiki/Dehydration) the precise amount depends on the level of activity, temperature, humidity, and other factors. Most of this is ingested through foods or beverages other than drinking straight water. It is not clear how much water intake is needed by healthy people, though the British Dietetic Association advises that 2.5 liters of total water daily is the minimum to maintain proper hydration, including 1.8 liters (6 to 7 glasses) obtained directly from beverages.[[45]](#page23) Medical literature favors a lower consumption, typically 1 liter of water for an average male, excluding extra requirements due to fluid loss from exercise or warm weather.[[46]](#page23)



Healthy kidneys can excrete 0.8 to 1 liter of water per hour, but stress such as exercise can reduce this amount. People can drink far more water than necessary while exercising, putting them at risk of [water intoxication](https://en.wikipedia.org/wiki/Water_intoxication) (hyperhydration),



which can be fatal.[[47][48]](#page23) The popular claim that "a person should consume eight glasses of water per day" seems to have no real basis in science.[[49]](#page23) Studies have shown that extra water intake, especially up to 500 milliliters (18 imp fl oz; 17 U.S. fl oz) at mealtime was conducive to weight loss.[[50][51][52][53][54][55]](#page24) Adequate fluid intake is helpful in preventing constipation.[[56]](#page24)

An original recommendation for water intake in 1945 by the Food and Nutrition Board of the [United States National Research Council](https://en.wikipedia.org/wiki/United_States_National_Research_Council) read: "An ordinary standard for diverse persons is 1 milliliter for each calorie of food. Most of this quantity is contained in prepared foods."[[57]](#page24) The latest dietary reference intake report by the [United States National Research Council](https://en.wikipedia.org/wiki/United_States_National_Research_Council) in general recommended, based on the median total water intake from US survey data (including food sources): 3.7 liters (0.81 imp gal; 0.98 U.S. gal) for men and 2.7 liters (0.59 imp gal; 0.71 U.S. gal) of water total for women, noting that water contained in food provided approximately 19% of total water intake in the survey.[[58]](#page24)



Specifically, pregnant and [breastfeeding](https://en.wikipedia.org/wiki/Breastfeeding) women need additional fluids to stay hydrated. The [Institute of Medicine](https://en.wikipedia.org/wiki/Institute_of_Medicine) (US) recommends that, on average, men consume 3 liters (0.66 imp gal; 0.79 U.S. gal) and women 2.2 liters (0.48 imp gal; 0.58 U.S. gal); pregnant women should increase intake to 2.4



liters (0.53 imp gal; 0.63 U.S. gal) and breastfeeding women should get 3 liters (12 cups), since an especially large amount of fluid is lost during nursing.[[59]](#page24) Also noted is that normally, about 20% of water intake comes from food, while the rest comes from drinking water and beverages [(caffeinated](https://en.wikipedia.org/wiki/Caffeine) included). Water is excreted from the body in multiple forms; through [urine](https://en.wikipedia.org/wiki/Urine) and [feces,](https://en.wikipedia.org/wiki/Feces) through [sweating,](https://en.wikipedia.org/wiki/Sweat) and by exhalation of water vapor in the breath. With physical exertion and heat exposure, water loss will increase and daily fluid needs may increase as well.

Humans require water with few impurities. Common impurities include metal salts and oxides, including copper, iron, calcium and lead,[[60]](#page24) and/or harmful bacteria, such as [*Vibrio*](https://en.wikipedia.org/wiki/Vibrio). Some [solutes](https://en.wikipedia.org/wiki/Solution) are acceptable and even desirable for taste enhancement and to provide needed [electrolytes.](https://en.wikipedia.org/wiki/Electrolyte)[[61]](#page24)



The single largest (by volume) freshwater resource suitable for drinking is [Lake Baikal](https://en.wikipedia.org/wiki/Lake_Baikal) in Siberia.[[62]](#page24)



**Washing**

The propensity of water to form [solutions](https://en.wikipedia.org/wiki/Solvation) and [emulsions](https://en.wikipedia.org/wiki/Emulsion) is useful in various [washing](https://en.wikipedia.org/wiki/Washing) processes. Washing is also an important component of several aspects of personal [body hygiene.](https://en.wikipedia.org/wiki/Body_hygiene) Most of personal water use is due to [showering,](https://en.wikipedia.org/wiki/Shower) doing the [laundry](https://en.wikipedia.org/wiki/Laundry) and [dishwashing,](https://en.wikipedia.org/wiki/Dishwashing) reaching hundreds of liters per day per person in developed countries.



**Transportation**

The use of water for transportation of materials through rivers and canals as well as the international shipping lanes is an important part of the world economy.

**Chemical uses**

Water is widely used in chemical reactions as a [solvent](https://en.wikipedia.org/wiki/Solvent) or [reactant](https://en.wikipedia.org/wiki/Reactant) and less commonly as a [solute](https://en.wikipedia.org/wiki/Solution) or [catalyst.](https://en.wikipedia.org/wiki/Catalyst) In inorganic reactions, water is a common solvent, dissolving many ionic compounds, as well as other polar compounds such as [ammonia](https://en.wikipedia.org/wiki/Ammonia) and [compounds closely related to water.](https://en.wikipedia.org/wiki/Hydrogen_chalcogenide) In organic reactions, it is not usually used as a reaction solvent, because it does not dissolve the reactants well and is [amphoteric](https://en.wikipedia.org/wiki/Amphoteric) (acidic *and* basic) and [nucleophilic.](https://en.wikipedia.org/wiki/Nucleophilic) Nevertheless, these properties are sometimes desirable. Also, acceleration of [Diels-Alder reactions](https://en.wikipedia.org/wiki/Diels-Alder_reaction) by water has been observed. [Supercritical water](https://en.wikipedia.org/wiki/Supercritical_water) has recently been a topic of research. Oxygen-saturated supercritical water combusts organic pollutants efficiently. Water vapor is used for some processes in the chemical industry. An example is the production of acrylic acid from acrolein, propylene and propane.[[63][64][65][66]](#page25) The possible effect of water in these reactions includes the physical-, chemical interaction of water with the catalyst and the chemical reaction of water with the reaction intermediates.



**Heat exchange**

Water and steam are a common fluid used for [heat exchange,](https://en.wikipedia.org/wiki/Heat_exchanger) due to its availability and high [heat capacity,](https://en.wikipedia.org/wiki/Heat_capacity_of_water) both for cooling and heating. Cool water may even be naturally available from a lake or the sea. It's especially effective to transport heat through [vaporization](https://en.wikipedia.org/wiki/Vaporization) and [condensation](https://en.wikipedia.org/wiki/Condensation) of water because of its large [latent heat of vaporization.](https://en.wikipedia.org/wiki/Latent_heat_of_vaporization) A disadvantage is that metals commonly [found in industries such as steel and copper are oxidized faster by untreated water and steam. In almost all thermal power](https://en.wikipedia.org/wiki/Thermal_power_station) [stations, water is used as the working fluid (used in a closed loop between boiler, steam turbine and condenser), and the coolant](https://en.wikipedia.org/wiki/Thermal_power_station) (used to exchange the waste heat to a water body or carry it away by [evaporation](https://en.wikipedia.org/wiki/Evaporation) in a [cooling tower)](https://en.wikipedia.org/wiki/Cooling_tower). In the United States, cooling power plants is the largest use of water.[[67]](#page25)



In the [nuclear power](https://en.wikipedia.org/wiki/Nuclear_power) industry, water can also be used as a [neutron moderator.](https://en.wikipedia.org/wiki/Neutron_moderator) In most [nuclear reactors,](https://en.wikipedia.org/wiki/Nuclear_reactor) water is both a coolant and [a moderator. This provides something of a passive safety measure, as removing the water from the reactor also slows the nuclear](https://en.wikipedia.org/wiki/Void_coefficient) [reaction down. However other methods are favored for stopping a reaction and it is preferred to keep the nuclear core covered](https://en.wikipedia.org/wiki/Void_coefficient) with water so as to ensure adequate cooling.



**Fire considerations**

Water has a high heat of vaporization and is relatively inert, which makes it a good [fire extinguishing](https://en.wikipedia.org/wiki/Fire_fighting" \l "Use_of_water) fluid. The evaporation of water carries heat away from the fire. It is dangerous to use water on fires involving oils and organic solvents, because many organic materials float on water and the water tends to spread the burning liquid.



[Use of water in fire fighting should also take into account the hazards of a steam](https://en.wikipedia.org/wiki/Steam_explosion) [explosion, which may occur when water is used on very hot fires in confined](https://en.wikipedia.org/wiki/Steam_explosion) spaces, and of a hydrogen explosion, when substances which react with water, such as certain metals or hot carbon such as coal, [charcoal,](https://en.wikipedia.org/wiki/Charcoal) or [coke](https://en.wikipedia.org/wiki/Coke_(fuel)) graphite, decompose the water, producing [water gas.](https://en.wikipedia.org/wiki/Water_gas)



The power of such explosions was seen in the [Chernobyl disaster,](https://en.wikipedia.org/wiki/Chernobyl_disaster) although the water involved did not come from fire-fighting at that time but the reactor's own water cooling system. A steam explosion occurred when the extreme overheating of the core caused water to flash into steam. A hydrogen explosion may have occurred as a result of reaction between steam and hot [zirconium.](https://en.wikipedia.org/wiki/Zirconium)



Water is used for [fighting](https://en.wikipedia.org/wiki/Fire_fighting) [wildfires.](https://en.wikipedia.org/wiki/Wildfire)



Some metallic oxides, most notably those of [alkali metals](https://en.wikipedia.org/wiki/Alkali_metals) and [alkaline earth metals,](https://en.wikipedia.org/wiki/Alkaline_earth_metals) produce so much heat on reaction with water that a fire hazard can develop. The alkaline earth oxide [quicklime](https://en.wikipedia.org/wiki/Calcium_oxide) is a mass-produced substance which is often transported in



paper bags. If these are soaked through, they may ignite as their contents react with water.[[68]](#page25)

**Recreation**

Humans use water for many recreational purposes, as well as for exercising and for sports. Some of these include swimming, [waterskiing,](https://en.wikipedia.org/wiki/Waterskiing) [boating,](https://en.wikipedia.org/wiki/Boating) [surfing](https://en.wikipedia.org/wiki/Surfing) and [diving.](https://en.wikipedia.org/wiki/Underwater_diving) In addition, some sports, like [ice hockey](https://en.wikipedia.org/wiki/Ice_hockey) and [ice skating,](https://en.wikipedia.org/wiki/Ice_skating) are played on ice. Lakesides, beaches and [water parks](https://en.wikipedia.org/wiki/Water_park) are popular places for people to go to relax and enjoy recreation. Many find the sound and appearance of flowing water to be calming, and fountains and other water features are popular decorations. Some keep fish and other life in [aquariums](https://en.wikipedia.org/wiki/Aquarium) or ponds for show, fun,



and companionship. Humans also use water for snow sports i.e. [skiing,](https://en.wikipedia.org/wiki/Skiing) [sledding,](https://en.wikipedia.org/wiki/Sledding) San Andrés island, Colombia.



[snowmobiling](https://en.wikipedia.org/wiki/Snowmobiling) or [snowboarding,](https://en.wikipedia.org/wiki/Snowboarding) which require the water to be frozen.



**Water industry**

[The water industry provides drinking water and wastewater services (including sewage](https://en.wikipedia.org/wiki/Sewage_treatment) [treatment) to households and industry.](https://en.wikipedia.org/wiki/Sewage_treatment) [Water supply](https://en.wikipedia.org/wiki/Water_supply) [facilities include](https://en.wikipedia.org/wiki/Sewage_treatment) [water wells,](https://en.wikipedia.org/wiki/Water_well) [cisterns](https://en.wikipedia.org/wiki/Cistern) [for rainwater harvesting, water supply networks, and water purification facilities, water](https://en.wikipedia.org/wiki/Water_tank) [tanks,](https://en.wikipedia.org/wiki/Water_tank) [water towers,](https://en.wikipedia.org/wiki/Water_tower) [water pipes](https://en.wikipedia.org/wiki/Water_pipe) [including old](https://en.wikipedia.org/wiki/Water_tank) [aqueducts.](https://en.wikipedia.org/wiki/Aqueduct_(watercourse)) [Atmospheric water generators](https://en.wikipedia.org/wiki/Atmospheric_water_generator) are in development.



Drinking water is often collected at [springs,](https://en.wikipedia.org/wiki/Spring_(hydrosphere)) extracted from artificial [borings](https://en.wikipedia.org/wiki/Boring_(earth)) (wells) in the ground, or pumped from lakes and rivers. Building more wells in adequate places is thus a possible way to produce more water, assuming the aquifers can supply an adequate flow. Other water sources include rainwater collection. Water may require purification for human consumption. This may involve removal of undissolved substances, dissolved substances and harmful [microbes.](https://en.wikipedia.org/wiki/Microbe) Popular methods are [filtering](https://en.wikipedia.org/wiki/Filter_(water)) with sand which only removes undissolved material, while [chlorination](https://en.wikipedia.org/wiki/Water_chlorination) and [boiling](https://en.wikipedia.org/wiki/Boiling) kill harmful microbes. [Distillation does all three functions. More advanced techniques exist, such as reverse](https://en.wikipedia.org/wiki/Reverse_osmosis) [osmosis.](https://en.wikipedia.org/wiki/Reverse_osmosis) [Desalination](https://en.wikipedia.org/wiki/Desalination) [of abundant](https://en.wikipedia.org/wiki/Reverse_osmosis) [seawater](https://en.wikipedia.org/wiki/Seawater) [is a more expensive solution used in coastal](https://en.wikipedia.org/wiki/Reverse_osmosis) [arid](https://en.wikipedia.org/wiki/Arid) [climates.](https://en.wikipedia.org/wiki/Climate)



A water-carrier in India, 1882. In many places where running water is not available, water has to be transported by people.



The distribution of drinking water is done through [municipal water systems,](https://en.wikipedia.org/wiki/Municipal_water_system) tanker delivery or as [bottled water.](https://en.wikipedia.org/wiki/Bottled_water) Governments in many countries have programs to distribute water to the needy at no charge.



Reducing usage by using drinking (potable) water only for human consumption is another option. In some cities such as Hong Kong, sea water is extensively used for flushing toilets citywide in order to [conserve fresh water resources.](https://en.wikipedia.org/wiki/Water_conservation)



[Polluting water](https://en.wikipedia.org/wiki/Water_pollution) may be the biggest single misuse of water; to the extent that a pollutant limits other uses of the water, it becomes a waste of the resource, regardless of benefits to the polluter. Like other types of pollution, this does not enter standard accounting of market costs, being conceived as [externalities](https://en.wikipedia.org/wiki/Externality) for which the market cannot account. Thus other people pay the price of water pollution, while the private firms' profits are not redistributed to the local population, victims of this pollution. [Pharmaceuticals](https://en.wikipedia.org/wiki/Pharmaceuticals) consumed by humans often end up in the waterways and can have detrimental effects on [aquatic](https://en.wikipedia.org/wiki/Marine_biology) life if they [bioaccumulate](https://en.wikipedia.org/wiki/Bioaccumulation) and if they are not [biodegradable.](https://en.wikipedia.org/wiki/Biodegradable)



[Municipal and industrial wastewater are typically treated at wastewater](https://en.wikipedia.org/wiki/Wastewater_treatment_plant) [treatment plants. Mitigation of polluted](https://en.wikipedia.org/wiki/Wastewater_treatment_plant) [surface runoff](https://en.wikipedia.org/wiki/Surface_runoff) [is addressed through a](https://en.wikipedia.org/wiki/Wastewater_treatment_plant) [variety of prevention and treatment techniques. (](https://en.wikipedia.org/wiki/Surface_runoff" \l "Mitigation_and_treatment)*See* Surface runoff#Mitigation [and treatment.)](https://en.wikipedia.org/wiki/Surface_runoff" \l "Mitigation_and_treatment)



**Industrial applications**

Many industrial processes rely on reactions using chemicals dissolved in water, suspension of solids in water [slurries](https://en.wikipedia.org/wiki/Slurry) or using water to dissolve and extract substances, or to wash products or process equipment. Processes such as [mining,](https://en.wikipedia.org/wiki/Mining) [chemical pulping,](https://en.wikipedia.org/wiki/Chemical_pulping) [pulp bleaching,](https://en.wikipedia.org/w/index.php?title=Pulp_bleaching&action=edit&redlink=1) [paper manufacturing,](https://en.wikipedia.org/wiki/Paper_manufacturing) textile production, dyeing, printing, and cooling of power plants use large amounts of water, requiring a dedicated water source, and often cause significant water pollution.



Water is used in [power generation.](https://en.wikipedia.org/wiki/Power_generation) [Hydroelectricity](https://en.wikipedia.org/wiki/Hydroelectricity) is electricity obtained from [hydropower.](https://en.wikipedia.org/wiki/Hydropower) Hydroelectric power comes from water driving a water turbine connected to a generator. Hydroelectricity is a low-cost, non-polluting, renewable energy source. The energy is supplied by the motion of water. Typically a dam is constructed on a river, creating an artificial lake behind it. Water flowing out of the lake is forced through turbines that turn generators.



A manual water [pump](https://en.wikipedia.org/wiki/Pump) in China



[Water purification](https://en.wikipedia.org/wiki/Water_purification) facility



[Reverse osmosis](https://en.wikipedia.org/wiki/Reverse_osmosis) (RO) [desalination](https://en.wikipedia.org/wiki/Desalination) plant in [Barcelona,](https://en.wikipedia.org/wiki/Barcelona) Spain



Water can be used to cook foods such as [noodles](https://en.wikipedia.org/wiki/Noodles)

[Three Gorges Dam](https://en.wikipedia.org/wiki/Three_Gorges_Dam) is the [largest hydro-electric power station.](https://en.wikipedia.org/wiki/List_of_the_largest_hydroelectric_power_stations)

Pressurized water is used in [water blasting](https://en.wikipedia.org/wiki/Hydrodemolition) and [water jet cutters.](https://en.wikipedia.org/wiki/Water_jet_cutter) Also, very high pressure water guns are used for precise cutting. It works very well, is relatively safe, and is not harmful to the environment. It is also used in the cooling of machinery to prevent overheating, or prevent saw blades from overheating.



Water is also used in many industrial processes and machines, such as the [steam turbine](https://en.wikipedia.org/wiki/Steam_turbine) and [heat exchanger,](https://en.wikipedia.org/wiki/Heat_exchanger) in addition to its use as a chemical [solvent.](https://en.wikipedia.org/wiki/Solvent) Discharge of untreated water from industrial uses is [pollution.](https://en.wikipedia.org/wiki/Water_pollution) Pollution includes discharged solutes (chemical pollution) and discharged coolant water [(thermal pollution)](https://en.wikipedia.org/wiki/Thermal_pollution). Industry requires pure water for many applications and utilizes a variety of purification techniques both in water supply and discharge.



**Food processing**

[Boiling,](https://en.wikipedia.org/wiki/Boiling) [steaming,](https://en.wikipedia.org/wiki/Steaming) and [simmering](https://en.wikipedia.org/wiki/Simmering) are popular cooking methods that often require immersing food in water or its gaseous state, steam.[[69]](#page25) Water is also used for [dishwashing.](https://en.wikipedia.org/wiki/Dishwashing) Water also plays many critical roles within the field of [food science.](https://en.wikipedia.org/wiki/Food_science) It is important for a food scientist to understand the roles that water plays within food processing to ensure the success of their products.



[Solutes](https://en.wikipedia.org/wiki/Solution) such as salts and sugars found in water affect the physical properties of water. The boiling and freezing points of water are affected by solutes, as well as [air pressure,](https://en.wikipedia.org/wiki/Air_pressure) which is in turn affected by altitude. Water boils at lower temperatures with the lower air pressure that occurs at higher elevations. One [mole](https://en.wikipedia.org/wiki/Mole_(unit)) of sucrose (sugar) per kilogram of water raises the boiling point of water by 0.51 °C (0.918 °F), and one mole of salt per kg raises the boiling point by



1.02 °C (1.836 °F); similarly, increasing the number of dissolved particles lowers water's freezing point.[[70]](#page25)

Solutes in water also affect water activity that affects many chemical reactions and the growth of microbes in food.[[71]](#page25) Water activity can be described as a ratio of the vapor pressure of water in a solution to the vapor pressure of pure water.[[70]](#page25) Solutes in water lower water activity—this is important to know because most bacterial growth ceases at low levels of water activity.[[71]](#page25) Not only does microbial growth affect the safety of food, but also the preservation and shelf life of food.

[Water hardness](https://en.wikipedia.org/wiki/Water_hardness) is also a critical factor in food processing and may be altered or treated by using a chemical ion exchange system. It can dramatically affect the quality of a product, as well as playing a role in sanitation. Water hardness is classified based on concentration of calcium carbonate the water contains. Water is classified as soft if it contains less than 100 mg/l (UK)[[72]](#page25) or less than 60 mg/l (US).[[73]](#page25)

According to a report published by the Water Footprint organization in 2010, a single kilogram of beef requires 15 thousand liters (3.3 ×103 imp gal; 4.0 ×103 U.S. gal) of water; however, the authors also make clear that this is a global average and circumstantial factors determine the amount of water used in beef production.[[74]](#page25)

**Medical use**

[Water for injection is on the World Health Organization's list of essential](https://en.wikipedia.org/wiki/World_Health_Organization's_list_of_essential_medicines) [medicines.](https://en.wikipedia.org/wiki/World_Health_Organization's_list_of_essential_medicines)[[75]](#page25)



**Distribution in nature**



**In the universe**

Much of the universe's water is produced as a byproduct of [star formation.](https://en.wikipedia.org/wiki/Star_formation) The formation of stars is accompanied by a strong outward wind of gas and dust. When this outflow of material eventually impacts the surrounding gas, the shock waves that are created compress and heat the gas. The water observed is quickly produced in this warm dense gas.[[77]](#page25)



On 22 July 2011, a report described the discovery of a gigantic cloud of water vapor containing "140 trillion times more water than all of Earth's oceans combined" around a [quasar](https://en.wikipedia.org/wiki/Quasar) located 12 billion light years from Earth. According to the researchers, the "discovery shows that water has been prevalent in the universe for nearly its entire existence".[[78][79]](#page26)



[Water has been detected in interstellar clouds within our galaxy, the Milky](https://en.wikipedia.org/wiki/Milky_Way)



[Way.](https://en.wikipedia.org/wiki/Milky_Way)[[80]](#page26) [Water probably exists in abundance in other galaxies, too, because its](https://en.wikipedia.org/wiki/Milky_Way) components, hydrogen and oxygen, are among the most abundant elements in [the universe. Based on models of the formation and evolution of the Solar](https://en.wikipedia.org/wiki/Formation_and_evolution_of_the_Solar_System) [System and that of other star systems, most other](https://en.wikipedia.org/wiki/Formation_and_evolution_of_the_Solar_System) [planetary systems](https://en.wikipedia.org/wiki/Planetary_system) [are likely to](https://en.wikipedia.org/wiki/Formation_and_evolution_of_the_Solar_System) have similar ingredients.



**Water vapor**

Water is present as vapor in:

[Atmosphere of the Sun:](https://en.wikipedia.org/wiki/Solar_atmosphere) in detectable trace amounts[[81]](#page26)



Sterile water for injection



Band 5 [ALMA](https://en.wikipedia.org/wiki/Atacama_Large_Millimeter_Array) receiver is an instrument specifically designed to detect water in the universe.[[76]](#page25)

[Atmosphere of Mercury:](https://en.wikipedia.org/wiki/Atmosphere_of_Mercury) 3.4%, and large amounts of water in [Mercury's](https://en.wikipedia.org/wiki/Mercury_(planet)) [exosphere](https://en.wikipedia.org/wiki/Exosphere)[[82]](#page26)



[Atmosphere of Venus:](https://en.wikipedia.org/wiki/Atmosphere_of_Venus) 0.002%[83]



[Earth's atmosphere:](https://en.wikipedia.org/wiki/Earth's_atmosphere) ≈0.40% over full atmosphere, typically 1–4% at surface; as well as [that of the Moon](https://en.wikipedia.org/wiki/Atmosphere_of_the_Moon) in trace amounts[[84]](#page26)



[Atmosphere of Mars:](https://en.wikipedia.org/wiki/Atmosphere_of_Mars) 0.03%[[85]](#page26)



[Atmosphere of Ceres](https://en.wikipedia.org/wiki/Atmosphere_of_Ceres)[[86]](#page26)



[Atmosphere of Jupiter:](https://en.wikipedia.org/wiki/Atmosphere_of_Jupiter) 0.0004%[[87]](#page26) – in [ices](https://en.wikipedia.org/wiki/Volatiles) only; and that of its moon [Europa](https://en.wikipedia.org/wiki/Europa_(moon))[[88]](#page26)



[Atmosphere of Saturn](https://en.wikipedia.org/wiki/Atmosphere_of_Saturn) – in [ices](https://en.wikipedia.org/wiki/Volatiles) only; and that of its moons [Titan](https://en.wikipedia.org/wiki/Titan_(moon)) (stratospheric), [Enceladus:](https://en.wikipedia.org/wiki/Enceladus_(moon)) 91%[[89]](#page26) and [Dione](https://en.wikipedia.org/wiki/Dione_(moon)) (exosphere)



[Atmosphere of Uranus](https://en.wikipedia.org/wiki/Atmosphere_of_Uranus) – in trace amounts below 50 bar



[Atmosphere of Neptune](https://en.wikipedia.org/wiki/Atmosphere_of_Neptune) – found in the deeper layers[[90]](#page26)



[Extrasolar planet atmospheres: including those of HD 189733 b](https://en.wikipedia.org/wiki/HAT-P-11b)[[91]](#page27) [and HD 209458 b,](https://en.wikipedia.org/wiki/HAT-P-11b)[[92]](#page27) [Tau Boötis b,](https://en.wikipedia.org/wiki/HAT-P-11b)[[93]](#page27) [HAT-P-11b,](https://en.wikipedia.org/wiki/HAT-P-11b)[[94][95]](#page27) [XO-1b,](https://en.wikipedia.org/wiki/XO-1b) [WASP-12b,](https://en.wikipedia.org/wiki/WASP-12b) [WASP-17b,](https://en.wikipedia.org/wiki/WASP-17b) [and](https://en.wikipedia.org/wiki/HAT-P-11b) [WASP-19b.](https://en.wikipedia.org/wiki/WASP-19b)[[96]](#page27)



[Stellar atmospheres: not limited to cooler stars and even detected in giant hot stars such as Betelgeuse, Mu](https://en.wikipedia.org/wiki/Mu_Cephei) [Cephei,](https://en.wikipedia.org/wiki/Mu_Cephei) [Antares](https://en.wikipedia.org/wiki/Antares) [and](https://en.wikipedia.org/wiki/Mu_Cephei) [Arcturus.](https://en.wikipedia.org/wiki/Arcturus)[[95][97]](#page27)



[Circumstellar disks: including those of more than half of T Tauri stars such as AA Tauri](https://en.wikipedia.org/wiki/TW_Hydrae)[[95]](#page27) [as well as TW](https://en.wikipedia.org/wiki/TW_Hydrae) [Hydrae,](https://en.wikipedia.org/wiki/TW_Hydrae)[[98][99]](#page27) [IRC +10216](https://en.wikipedia.org/wiki/IRC_%2B10216)[[100]](#page27) [and](https://en.wikipedia.org/wiki/TW_Hydrae) [APM 08279+5255,](https://en.wikipedia.org/wiki/APM_08279%2B5255)[[78][79]](#page26) [VY Canis Majoris](https://en.wikipedia.org/wiki/VY_Canis_Majoris) [and](https://en.wikipedia.org/wiki/TW_Hydrae) [S Persei.](https://en.wikipedia.org/wiki/S_Persei)[[97]](#page27)



**Liquid water**

[Liquid water is present on Earth, covering 71% of its surface.](https://en.wikipedia.org/wiki/Water_on_Mars)[[1]](#page20) [Liquid water is also occasionally present in small amounts on](https://en.wikipedia.org/wiki/Water_on_Mars) [Mars. Scientists believe liquid water is present in the Saturnian moons of](https://en.wikipedia.org/wiki/Water_on_Mars) [Enceladus,](https://en.wikipedia.org/wiki/Enceladus_(moon)) [as a 10-kilometre thick ocean approximately](https://en.wikipedia.org/wiki/Water_on_Mars) 30–40 kilometres below Enceladus' south polar surface,[[101][102]](#page27) and [Titan,](https://en.wikipedia.org/wiki/Titan_(moon)) as a subsurface layer, possibly mixed with



[ammonia.](https://en.wikipedia.org/wiki/Ammonia)[[103]](#page27) Jupiter's moon [Europa](https://en.wikipedia.org/wiki/Europa_(moon)) has surface characteristics which suggest a subsurface liquid water ocean.[[104]](#page28) Liquid water may also exist on Jupiter's moon [Ganymede](https://en.wikipedia.org/wiki/Ganymede_(moon)) as a layer sandwiched between high pressure ice and rock.[[105]](#page28)



**Water ice**

Water is present as ice on:



South polar ice cap of Mars during Martian south summer 2000

[Mercury's](https://en.wikipedia.org/wiki/Mercury_(planet)) poles[[122]](#page29)



[Tethys](https://en.wikipedia.org/wiki/Tethys_(moon))[[123]](#page29)



[Mars:](https://en.wikipedia.org/wiki/Water_on_Mars) under the regolith and at the poles.[[106][107]](#page28)



Earth–Moon system: mainly as [ice sheets](https://en.wikipedia.org/wiki/Ice_sheet) on Earth and in Lunar craters and volcanic rocks[[108]](#page28) NASA reported the detection of water molecules by NASA's Moon Mineralogy Mapper aboard the Indian Space Research



Organization's Chandrayaan-1 spacecraft in September 2009.[[109]](#page28)

[Ceres](https://en.wikipedia.org/wiki/Ceres_(dwarf_planet))[[110][111][112]](#page28)



Jupiter's moons: [Europa's](https://en.wikipedia.org/wiki/Europa_(moon)) surface and also that of [Ganymede](https://en.wikipedia.org/wiki/Ganymede_(moon))[[113]](#page28) and



[Callisto](https://en.wikipedia.org/wiki/Callisto_(moon))[[114][115]](#page28)



Saturn: in the [planet's ring system](https://en.wikipedia.org/wiki/Rings_of_Saturn)[[116]](#page28) and on the surface and mantle of [Titan](https://en.wikipedia.org/wiki/Titan_(moon))[[117]](#page28) and [Enceladus](https://en.wikipedia.org/wiki/Enceladus_(moon))[[118]](#page29)



[Pluto–Charon](https://en.wikipedia.org/wiki/Charon_(moon)) system[[116]](#page28)



[Comets](https://en.wikipedia.org/wiki/Comets)[[119][120]](#page29) and other related [Kuiper belt](https://en.wikipedia.org/wiki/Kuiper_belt) and [Oort cloud](https://en.wikipedia.org/wiki/Oort_cloud) objects[[121]](#page29)



And is also likely present on:

**Exotic forms**

Water and other [volatiles](https://en.wikipedia.org/wiki/Volatiles) probably comprise much of the internal structures of [Uranus](https://en.wikipedia.org/wiki/Uranus) and [Neptune](https://en.wikipedia.org/wiki/Neptune) and the water in the deeper layers may be in the form of [ionic water](https://en.wikipedia.org/wiki/Ionic_water) in which the molecules break down into a soup of hydrogen and oxygen ions, and deeper



still as [superionic water](https://en.wikipedia.org/wiki/Superionic_water) in which the oxygen crystallises but the hydrogen ions float about freely within the oxygen lattice.[[124]](#page29)



**Water and habitable zone**

The existence of liquid water, and to a lesser extent its gaseous and solid forms, on Earth are vital to the existence of [life on Earth](https://en.wikipedia.org/wiki/Organism) as we know it. The Earth is located in the [habitable zone](https://en.wikipedia.org/wiki/Habitable_zone) of the [solar system;](https://en.wikipedia.org/wiki/Solar_system) if it were slightly closer to or farther from the [Sun](https://en.wikipedia.org/wiki/Sun) (about 5%, or about 8 million kilometers), the conditions which allow the three forms to be present simultaneously would be far less likely to exist.[[125][126]](#page29)



Earth's [gravity](https://en.wikipedia.org/wiki/Gravity) allows it to hold an [atmosphere.](https://en.wikipedia.org/wiki/Celestial_body_atmosphere) Water vapor and carbon dioxide in the atmosphere provide a temperature buffer [(greenhouse effect)](https://en.wikipedia.org/wiki/Greenhouse_effect) which helps maintain a relatively steady surface temperature. If Earth were smaller, a thinner atmosphere would allow temperature extremes, thus preventing the accumulation of water except in [polar ice caps](https://en.wikipedia.org/wiki/Polar_ice_cap) (as on [Mars)](https://en.wikipedia.org/wiki/Mars).



The surface temperature of Earth has been relatively constant through [geologic time](https://en.wikipedia.org/wiki/Geologic_time) despite varying levels of incoming solar radiation [(insolation),](https://en.wikipedia.org/wiki/Insolation) indicating that a dynamic process governs Earth's temperature via a combination of greenhouse gases and surface or atmospheric [albedo.](https://en.wikipedia.org/wiki/Albedo) This proposal is known as the [*Gaia hypothesis*](https://en.wikipedia.org/wiki/Gaia_hypothesis).



The state of water on a planet depends on ambient pressure, which is determined by the planet's gravity. If a planet is sufficiently massive, the water on it may be solid even at high temperatures, because of the high pressure caused by gravity, as it was observed on exoplanets [Gliese 436 b](https://en.wikipedia.org/wiki/Gliese_436_b)[[127]](#page29) and [GJ 1214](https://en.wikipedia.org/wiki/GJ_1214_b) b.[[128]](#page29)



**Law, politics, and crisis**



[Water politics](https://en.wikipedia.org/wiki/Water_politics) is politics affected by water and [water resources.](https://en.wikipedia.org/wiki/Water_resources) For this reason, water is a strategic resource in the globe and an important element in many political conflicts. It causes health impacts and damage to biodiversity.



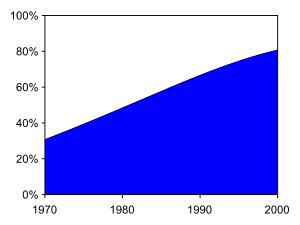
Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate [sanitation.](https://en.wikipedia.org/wiki/Sanitation)[[129]](#page29) However, some observers have estimated that by 2025 more than half of the [world population](https://en.wikipedia.org/wiki/World_population)



will be facing water-based vulnerability.[[130]](#page29) A report, issued in November 2009, suggests that by 2030, in some developing regions of the world, water demand will exceed supply by

[50%.[131]](#page29)

An estimate of the share of people in developing countries with access to [potable water](https://en.wikipedia.org/wiki/Potable_water) 1970–2000



1.6 billion people have gained access to a safe water source since

1990.[[132]](#page30) The proportion of people in developing countries with access to safe water is calculated to have improved from 30% in 1970[[133]](#page30) to 71% in 1990, 79% in 2000 and 84% in 2004. This trend is projected to continue.[[129]](#page29) To halve, by 2015, the proportion of people without sustainable access to safe drinking water is one of the [Millennium Development Goals.](https://en.wikipedia.org/wiki/Millennium_Development_Goals) This goal is projected to be reached.



A 2006 United Nations report stated that "there is enough water for everyone", but that access to it is hampered by [mismanagement and corruption.](https://en.wikipedia.org/wiki/Paris_Declaration_on_Aid_Effectiveness)[[134]](#page30) [In addition, global initiatives to improve the efficiency of aid delivery, such as the Paris](https://en.wikipedia.org/wiki/Paris_Declaration_on_Aid_Effectiveness) [Declaration on Aid Effectiveness, have not been taken up by water sector donors as effectively as they have in education and](https://en.wikipedia.org/wiki/Paris_Declaration_on_Aid_Effectiveness) health, potentially leaving multiple donors working on overlapping projects and recipient governments without empowerment to



[act.[135]](#page30)

The authors of the 2007 [Comprehensive Assessment of Water Management in Agriculture](https://en.wikipedia.org/wiki/Comprehensive_Assessment_of_Water_Management_in_Agriculture) cited poor governance as one reason for some forms of water scarcity. Water governance is the set of formal and informal processes through which decisions related to water management are made. Good water governance is primarily about knowing what processes work best in a particular physical and socioeconomic context. Mistakes have sometimes been made by trying to apply 'blueprints' that work in the [developed world to developing world locations and contexts. The Mekong river is one example; a review by the International](https://en.wikipedia.org/wiki/International_Water_Management_Institute) [Water Management Institute of policies in six countries that rely on the Mekong river for water found that thorough and](https://en.wikipedia.org/wiki/International_Water_Management_Institute) transparent cost-benefit analyses and environmental impact assessments were rarely undertaken. They also discovered that Cambodia's draft water law was much more complex than it needed to be.[[136]](#page30)



The [UN World Water Development Report](https://en.wikipedia.org/wiki/UN_World_Water_Development_Report) (WWDR, 2003) from the [World Water Assessment Program](https://en.wikipedia.org/wiki/World_Water_Assessment_Program) indicates that, in the next 20 years, the quantity of water available to everyone is predicted to decrease by 30%. 40% of the world's inhabitants currently have insufficient fresh water for minimal [hygiene.](https://en.wikipedia.org/wiki/Hygiene) More than 2.2 million people died in 2000 from [waterborne diseases](https://en.wikipedia.org/wiki/Waterborne_diseases) (related to



the consumption of contaminated water) or drought. In 2004, the UK charity [WaterAid](https://en.wikipedia.org/wiki/WaterAid) reported that a child dies every 15 seconds from easily preventable water-related diseases; often this means lack of [sewage](https://en.wikipedia.org/wiki/Sewage) disposal; see toilet.



Organizations concerned with water protection include the [International Water Association](https://en.wikipedia.org/wiki/International_Water_Association) (IWA), [WaterAid,](https://en.wikipedia.org/wiki/WaterAid) [Water 1st,](https://en.wikipedia.org/wiki/Water_1st) and the American Water Resources Association. The [International Water Management Institute](https://en.wikipedia.org/wiki/International_Water_Management_Institute) undertakes projects with the aim of using [effective water management to reduce poverty. Water related conventions are United Nations Convention to Combat](https://en.wikipedia.org/wiki/United_Nations_Convention_to_Combat_Desertification) [Desertification (UNCCD), International Convention for the Prevention of Pollution from Ships, United Nations Convention on](https://en.wikipedia.org/wiki/United_Nations_Convention_on_the_Law_of_the_Sea) [the Law of the Sea and](https://en.wikipedia.org/wiki/United_Nations_Convention_on_the_Law_of_the_Sea) [Ramsar Convention.](https://en.wikipedia.org/wiki/Ramsar_Convention) [World Day for Water](https://en.wikipedia.org/wiki/World_Day_for_Water) [takes place on 22 March and](https://en.wikipedia.org/wiki/United_Nations_Convention_on_the_Law_of_the_Sea) [World Ocean Day](https://en.wikipedia.org/wiki/World_Ocean_Day) [on 8 June.](https://en.wikipedia.org/wiki/United_Nations_Convention_on_the_Law_of_the_Sea)



**In culture**



**Religion**

Water is considered a purifier in most religions. Faiths that incorporate ritual washing [(ablution)](https://en.wikipedia.org/wiki/Ritual_purification) include [Christianity,](https://en.wikipedia.org/wiki/Christianity) [Hinduism,](https://en.wikipedia.org/wiki/Hinduism) [Islam,](https://en.wikipedia.org/wiki/Islam) [Judaism,](https://en.wikipedia.org/wiki/Judaism) the [Rastafari movement,](https://en.wikipedia.org/wiki/Rastafari_movement) [Shinto,](https://en.wikipedia.org/wiki/Shinto) [Taoism,](https://en.wikipedia.org/wiki/Taoism) and [Wicca.](https://en.wikipedia.org/wiki/Wicca) Immersion (or [aspersion](https://en.wikipedia.org/wiki/Aspersion) or [affusion)](https://en.wikipedia.org/wiki/Affusion) of a person in water is a central [sacrament](https://en.wikipedia.org/wiki/Sacrament) of Christianity (where it is called [baptism);](https://en.wikipedia.org/wiki/Baptism) it is also a part of the practice of other religions, including Islam ([*Ghusl*](https://en.wikipedia.org/wiki/Ghusl)), Judaism ([*mikvah*](https://en.wikipedia.org/wiki/Mikvah)) and [Sikhism](https://en.wikipedia.org/wiki/Sikhism) ([*Amrit Sanskar*](https://en.wikipedia.org/wiki/Amrit_Sanskar)). In addition, a ritual bath in pure water is performed for the dead in many religions including Islam and Judaism. In Islam, the five daily prayers can be done in most cases after completing washing certain parts of the body using clean water ([*wudu*](https://en.wikipedia.org/wiki/Wudu)), unless water is unavailable (see [*Tayammum*](https://en.wikipedia.org/wiki/Tayammum)). In Shinto, water is used in almost all rituals to cleanse a person or an area (e.g., in the ritual of [*misogi*](https://en.wikipedia.org/wiki/Misogi)).



In Christianity, [holy water](https://en.wikipedia.org/wiki/Holy_water) is water that has been sanctified by a priest for the purpose of [baptism,](https://en.wikipedia.org/wiki/Baptism) the [blessing](https://en.wikipedia.org/wiki/Blessing_(Roman_Catholic_Church)) of persons, places, and objects, or as a means of repelling evil.[[137][138]](#page30)



In [Zoroastrianism,](https://en.wikipedia.org/wiki/Zoroastrianism) water ([*āb*](https://en.wikipedia.org/wiki/Aban)) is respected as the source of life.[[139]](#page30)



**Philosophy**

The Ancient Greek philosopher [Empedocles](https://en.wikipedia.org/wiki/Empedocles) held that water is one of the four [classical elements](https://en.wikipedia.org/wiki/Classical_elements) along with fire, earth and [air,](https://en.wikipedia.org/wiki/Air_(classical_element)) and was regarded as the [ylem,](https://en.wikipedia.org/wiki/Ylem) or basic substance of the universe. [Thales,](https://en.wikipedia.org/wiki/Thales) who was portrayed by Aristotle as an astronomer and an engineer, theorized that the earth, which is denser than water, emerged from the water. Thales, a [monist,](https://en.wikipedia.org/wiki/Monist) believed further that all things are made from water. Plato believed the shape of water is an [icosahedron](https://en.wikipedia.org/wiki/Icosahedron) which accounts for why it is able to flow easily compared to the cube-shaped earth.[[140]](#page30)



[In the theory of the four bodily humors, water was associated with phlegm, as being cold and moist. The classical element of](https://en.wikipedia.org/wiki/Water_(classical_element)) [water was also one of the](https://en.wikipedia.org/wiki/Water_(classical_element)) [five elements](https://en.wikipedia.org/wiki/Five_elements_(Chinese_philosophy)) [in traditional](https://en.wikipedia.org/wiki/Water_(classical_element)) [Chinese philosophy,](https://en.wikipedia.org/wiki/Chinese_philosophy) [along with](https://en.wikipedia.org/wiki/Water_(classical_element)) [earth,](https://en.wikipedia.org/wiki/Earth_(classical_element)) [fire,](https://en.wikipedia.org/wiki/Fire_(classical_element)) [wood,](https://en.wikipedia.org/wiki/Wood_(classical_element)) [and](https://en.wikipedia.org/wiki/Water_(classical_element)) [metal.](https://en.wikipedia.org/wiki/Metal_(classical_element))



Water is also taken as a role model in some parts of traditional and popular [Asian philosophy.](https://en.wikipedia.org/wiki/Asian_philosophy) [James Legge's](https://en.wikipedia.org/wiki/James_Legge) 1891 translation of the [*Dao De Jing*](https://en.wikipedia.org/wiki/Dao_De_Jing) states, "The highest excellence is like (that of) water. The excellence of water appears in its benefiting all things, and in its occupying, without striving (to the contrary), the low place which all men dislike. Hence (its way) is near to (that of) the [Tao"](https://en.wikipedia.org/wiki/Tao) and "There is nothing in the world more soft and weak than water, and yet for attacking things that are firm and strong there



is nothing that can take precedence of it—for there is nothing (so effectual) for which it can be changed."[[141] *Guanzi*](#page30) in the "Shui



di" 水地 chapter further elaborates on the symbolism of water, proclaiming that "man is water" and attributing natural qualities of the people of different Chinese regions to the character of local water resources.[[142]](#page30)

**Dihydrogen monoxide hoax**

Water's technically correct but rarely used [chemical name,](https://en.wikipedia.org/wiki/Chemical_name) "dihydrogen monoxide", has been used in a series of [hoaxes](https://en.wikipedia.org/wiki/Hoaxes) and



[pranks that mock scientific illiteracy. This began in 1983, when an April Fools' Day article appeared in a newspaper in Durand,](https://en.wikipedia.org/wiki/Durand,_Michigan)



[Michigan. The false story consisted of safety concerns about the substance.](https://en.wikipedia.org/wiki/Durand,_Michigan)[[143]](#page30)



**See also**



The [water (data page)](https://en.wikipedia.org/wiki/Water_(data_page)) is a collection of the chemical and physical properties of water.



[Aquaphobia](https://en.wikipedia.org/wiki/Aquaphobia) (fear of water)



[Dihydrogen monoxide hoax](https://en.wikipedia.org/wiki/Dihydrogen_monoxide_hoax)



[List of national drinks](https://en.wikipedia.org/wiki/List_of_national_drinks)



[Mirage](https://en.wikipedia.org/wiki/Mirage)



[Mpemba effect](https://en.wikipedia.org/wiki/Mpemba_effect)



[Oral rehydration therapy](https://en.wikipedia.org/wiki/Oral_rehydration_therapy)



[Ripple effect](https://en.wikipedia.org/wiki/Ripple_effect)



[Thirst](https://en.wikipedia.org/wiki/Thirst)



[Water pinch analysis](https://en.wikipedia.org/wiki/Water_pinch_analysis)