UN WATER

United Nations
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The United Nations World Water Development Report 2021

VALUING WATER

Facts and figures

United Nations
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World Water
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Programme

Water availability

Water stress, essentially measured as water use as a function of available supply, affects many parts of the world. Over two billion people live in countries experiencing water stress (United Nations, 2018).[1]

Physical water stress is often a seasonal rather than an annual phenomenon, as exemplified by the seasonal variability in water availability. An estimated four billion people live in areas that suffer from severe physical water scarcity for at least one month per year (Mekonnen and Hoekstra, 2016).

About 1.6 billion people face 'economic' water scarcity, which means that while water may be physically available, they lack the necessary infrastructure to access that water (Comprehensive Assessment of Water Management in Agriculture, 2007).

Several of the world's main aquifers are under increasing stress and 30% of the largest groundwater systems are being depleted (Richey et al., 2015). Water withdrawals for irrigation are the primary driver of groundwater depletion worldwide (Burek et al., 2016).

Water storage

Globally, built reservoir capacity per person is decreasing, as reservoir expansion has not been able to keep pace with population growth, but also because storage capacity of existing reservoirs is decreasing, chiefly due to sedimentation.

Average annual storage volume losses equal about 1% of total built reservoir capacity, and the estimated costs for restoring these losses are approximately US$13 billion per year (George et al., 2017). An assessment of the value of storage capacity for enhancing water security in the world's 400 largest river basins identified water shortage risks in many parts of Africa, as well as in Australia, northern China, India, Spain and the western USA (Gaupp et al., 2015).

There are widespread declines in total water storage and associated freshwater availability that are primarily attributed to the intensive overextraction of groundwater and an increasing temperature-induced surface water loss (Liu et al., 2019).

Water demand and use

Global freshwater use has increased by a factor of six over the past 100 years and continues to grow at a rate of roughly 1% per year since the 1980s (AQUASTAT, n.d.). Much of this growth can be attributed to a combination of population growth, economic development and shifting consumption patterns.

Agriculture currently accounts for 69% of global water withdrawals, which are mainly used for irrigation but also include water used for livestock and aquaculture. This ratio can reach up to 95% in some developing countries (FAO, 2011a).

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1 For all sources cited in this document, please refer to the full report available at www.unesco.org/water/wwap.

Industry (including energy and power generation) accounts for 19%, while municipalities are responsible for the remaining 12% (AQUASTAT, 2016).

Globally, agriculture accounts for only about 4% of global Gross Domestic Product (GDP) with an average contribution per country of 10.39%, the trend being a decreasing share of GDP (World Bank, 2020). Such figures suggest that the value added of water use in agriculture is very low.

The Food and Agriculture Organization of the United Nations (FAO) estimates, based on a business-as-usual scenario, that the world will need about 60% more food by 2050, and that irrigated food production will increase by more than 50% over the same period (FAO, 2017a). The necessary amounts of water for these developments are not available. FAO recognizes that the amounts of water withdrawn by agriculture can only increase by 10%.

The 2030 Water Resources Group (2009) concluded that the world would face a 40% global water deficit by 2030 under a business-as-usual scenario.

Water quality

Water quality has deteriorated as a result of pollution in nearly all major rivers in Africa, Asia and Latin America. Nutrient loading, which is often associated with pathogen loading, are among the most prevalent sources of pollution (UNEP, 2016).

Significant data gaps for wastewater remain. For example, reporting on the Sustainable Development Goals (SDG) Indicator 6.3.1, the proportion of wastewater safely treated, shows that 59% of domestic wastewater flow is collected and safely treated, but this is based on data from only 79 countries, mostly high- and middle-income, and the data on industrial wastewater are insufficient (United Nations, 2018). It has been estimated that only 8% of industrial and municipal wastewater in low-income countries undergoes treatment of any kind (Sato et al., 2013).

Globally, an estimated 80% of all industrial and municipal wastewater is released into the environment without any prior treatment, with detrimental effects on human health and ecosystems (WWAP, 2017). This ratio is much higher in least developed countries, where sanitation and wastewater treatment facilities are grossly lacking.

About 380 billion m^3 of water can be recovered from the annual volumes of wastewater produced. This type of water recovery is expected to reach 470 billion m^3 by 2030 and 574 billion m^3 by 2050 (Qadir et al., 2020).

Recovering water, nutrients, precious metals and energy from waste streams are means of delivering value added (WWAP, 2017). The full recovery of nitrogen, phosphorus and potassium from wastewater can offset 13.4% of the global demand for these nutrients in agriculture but current technologies of nutrient recovery from wastewater have yet to reach 100% efficiency levels (Fernández-Arévalo et al., 2017; Ward et al., 2018). Beyond nutrient recovery and economic gains, there are critical environmental benefits, such as a reduction in eutrophication (Mayer et al., 2016).

In Australia, for example, algal blooms associated with excessive nutrients in freshwater systems cost US$116–155 million annually, including through major disruptions of water supplies for livestock and urban areas, as well as fish kills (OECD, 2017a).

One study puts the value of wastewater at US$1.1 trillion, with that number expected to rise to US$2 trillion by 2050 according to a model focusing on water reuse, energy, nutrients and metals (Stacklin, 2012).

Extreme events

Over the period 2009–2019, floods caused nearly 55,000 deaths (including 5,110 in 2019 alone), affected another 103 million people (including 31,000 in 2019 alone) and caused US$76.8 billion in economic losses (including US$36.8 billion in 2019 alone) (CRED, 2020). Over the same period, droughts affected over 100 million people, killing over 2,000 people more, and directly causing over US$10 billion in economic losses (CRED, 2020).

Globally, floods and extreme rainfall events have increased by more than 50% over the past decade, occurring at a rate four times greater than in 1980 (EASAC, 2018). Climate change is expected to further increase the frequency and severity of floods and droughts (IPCC, 2018).

Risk and resilience

Water shortages consistently rank among the global risks of greatest concern to policy-makers and business leaders (World Economic Forum, 2019).

In a survey of 525 investors with US$96 trillion in assets, 45% reported exposure to substantive risks from water insecurity – risks that threaten their reputation and license to operate, the security of their supply chains, their financial stability, and their ability to grow. Among the companies reporting exposure, the combined business value at risk topped out at US$425 billion with about 40% of the risks anticipated to hit within the next 1–3 years (CDP, 2020).

The World Bank (2016a) estimated that regions affected by water scarcity could see their growth rates decline by as much as 6% of GDP by 2050 as a result of losses in agriculture, health, income and property – sending them into sustained negative growth.

Economic valuation of the environment and infrastructure

Significant values can be attributed to ecosystem services that relate to supporting resilience or reducing risks. In 2019, environment-related risks accounted for three of the top five risks by likelihood and four of the top five by impact (World Economic Forum, 2019). Most disaster risks and costs are water-related.

The value of nature's contribution to people outstrips other economic values. One estimate of the notional economic value of nature's contribution to people was US$125 trillion per year in 2011, around two-thirds higher than global GDP at that time. Only the water-related services provided by nature are valued at US$29 trillion per year (Costanza et al., 2014).

The costs of inaction, in terms of ecosystem loss and degradation, are high. As reported by the Organisation for Economic Co-operation and Development (OECD, 2019, p. 9), *"between 1997 and 2011, the world lost an estimated US$4–20 trillion per year in ecosystem services owing to land cover change and US$6–11 trillion per year from land degradation."*

By 2030, investment in water and sanitation infrastructure will need to be around US$0.9–1.5 trillion per year, roughly 20% of the total requirement for all types of infrastructure investment (OECD, 2017b). About 70% of this total infrastructure investment will be in the global South, with a large share in rapidly growing urban areas (GCEC, 2016). In developed countries, large investments will be required for renovation and upgrade.

Investments in both grey and green water infrastructure have the potential to deliver a good economic return, in addition to often unquantifiable social and human welfare returns. There are some estimates of national water infrastructure value that can be implied from projected benefits delivered. For example, in the USA, current national water infrastructure capital needs are US$123 billion per year, with an aggregate economic impact of US$220 billion in annual economic activity and 1.3 million jobs, and an added indirect benefit of US$140 billion (The Value of Water Campaign, 2017). But these kinds of estimates are not available for the majority of countries.

Some indications of global values can be implied from the costs of infrastructure deficits or infrastructure failure. In 2015, the economic losses caused by water risks were estimated at approximately US$500 billion annually (Sadoff et al., 2015).

In the USA, service disruptions put US$43.5 billion in daily economic activity at risk (The Value of Water Campaign, 2017).

A recent World Bank study found that only 35% of utilities can cover operation and maintenance costs through revenues generated by tariffs, and only 14% can cover all economic costs related to service provision (Andres et al., 2019). Even fewer of these utilities can cover the original capital costs, which are often on par or higher than operation and maintenance costs (for instance, capital costs amount to an average of 49% of total costs for water utilities in the United Kingdom (Kingdom et al., 2018)).

About half of global utilities use increasing block tariffs. They are especially popular in Latin America (70% of the utilities), the Middle East and North Africa (74%), and East Asia and the Pacific (78%). The uniform volumetric tariff is the next most common water tariff, and used in many developed countries (44%). It is the dominant practice in Europe and Central Asia (85%) (IBNet Tariffs database, 2018).

Valuing water supply, sanitation and hygiene (WASH) services in human settlements

In 2017, 5.3 billion people (71% of the global population) used a safely managed drinking water service – one located on premises, available when needed and free from contamination. 3.4 billion people (or 45% of the global population) used safely managed sanitation services – an improved toilet or latrine that is not shared, from which excreta are safely disposed of *in situ* or treated off-site (WHO/UNICEF, 2019a).

Each year, it is estimated that approximately 829,000 people die from diarrhoea as a result of unsafe drinking water, sanitation and hand hygiene. These causes represent 60% of all deaths due to diarrhoea globally, including nearly 300,000 children under the age of five, 5.3% of all deaths in this age group (Prüss-Üstün et al., 2019).

Poor sanitation and hygiene, as well as unsafe drinking water, cause diarrhoeal disease and environmental enteropathy, which inhibit nutrient absorption, resulting in undernutrition (Teague et al., 2014). Roughly 50% of all malnutrition is associated with repeated diarrhoea or intestinal worm infections as a direct result of inadequate water, sanitation and hygiene (Prüss-Üstün et al., 2008).

An estimated 45% of all deaths of children under the age of five is from undernutrition (United Nations, 2018). The economic cost of undernutrition is estimated to be up to US$2.1 trillion (FAO, 2013a).

A recent assessment of the impact of unsafe WASH on childhood diarrhoeal disease suggests that household connections to water supplies and higher levels of sanitation coverage in communities lower risks of diarrhoeal morbidity. The assessment found that piped water of higher quality and continuous availability to premises reduced diarrhoea risk by 75%, compared to a baseline of unimproved drinking water. Sanitation interventions reduced diarrhoeal risk by 25%, with evidence for greater reductions when high sanitation coverage is reached, while interventions promoting handwashing with soap reduced these risks by 30%, compared with no intervention (Wolf et al., 2018).

Hand hygiene is extremely important to prevent the spread of COVID-19 (WHO, 2020a). Globally, over three billion people and two out of five health care facilities lack adequate access to hand hygiene facilities (WHO/UNICEF, 2019b).

At the global level, 11% of maternal deaths, mostly in low- and middle-income countries, are caused by infections linked to unhygienic conditions during labour and birth at home or in facilities, and to poor hygiene practices in the six weeks after birth (WHO/UNICEF, 2019b). Infections associated with unclean births may account for more than one million deaths each year (WHO/UNICEF, 2019b). Basic hygiene practices during antenatal care, labour and birth can reduce the risk of infections, sepsis and death of infants and mothers by up to 25% (PMNCH, 2014).

WHO/UNICEF (2018) showed that 69% of schoolchildren had access to drinking water (based on data from 92 countries), 66% to sanitation (in 101 countries) and 53% to hygiene (in 81 countries). This equates to 570 million children lacking drinking water in schools, 620 million lacking sanitation and 900 million lacking hygiene. UNDP (2006) reported that over 443 million school days are lost due to water-related illnesses.

Around 230 million people, mostly women and girls, spent more than 30 minutes per trip collecting water from sources away from their home (WHO/UNICEF, 2017a). This puts them at additional risk of attack or rape. Across 61 countries, women and girls were responsible for carrying water in eight out of ten households. The United Nations Children's Fund (UNICEF) has calculated how much time women and girls spend carrying water every day, which equals 200 million hours, or 8.3 million days, or 22,800 years (UNICEF, 2016).

It is estimated that at least US$6.5 billion is lost per year in working days due to a lack of access to sanitation (WHO, 2012). In addition, almost 400,000 work-related deaths occur each year from communicable diseases, which have the main contributing factors being poor-quality drinking water, and poor sanitation and hygiene (WWAP, 2016).

Access to WASH in the workplace is also an issue that impacts gender equality and women's workplace productivity. It was shown that in the Philippines and Viet Nam, in workplaces where WASH facilities were inadequate and assuming women would be absent for at least one day during their menstrual period for lack of such facilities, this would equate to 13.8 million and 1.5 million workday absences, respectively, and US$13 million and 1.28 million in economic losses (Sommer et al., 2016).

The World Health Organization (WHO) estimated that the total economic losses associated with inadequate WASH services amount to US$260 billion annually in 136 low- and middle-income countries, which is roughly equivalent to an average annual loss of 1.5% of the aggregate GDP of those countries (WHO, 2012).

It has been estimated that achieving universal access to safe drinking water, sanitation and hygiene (SDG Targets 6.1 and 6.2) in 140 low- and middle-income countries would cost approximately US$1.7 trillion from 2016 to 2030, or US$114 billion per year (Hutton and Varughese, 2016).

According to research done across ten low- and middle-income countries, on average, 56% of subsidies end up in the pockets of the richest 20%, while only 6% of subsidies find their way to the poorest 20% (Andres et al., 2019). The *2019 World Water Development Report* observed that people living in informal settlements often pay 10–20 times more for their water, which comes from suppliers such as water tankers (WWAP, 2019).

While it has previously been reported that returns on investment in sanitation, based on the global averages, deliver over twice the return on investment compared to drinking water (WHO, 2012), new analysis by Hutton (2018), based on disaggregated data between rural and urban areas, suggest that current benefit–cost ratios (BCRs) favour drinking water supply (with BCRs of 3.4 and 6.8 for urban and rural areas respectively) over sanitation (with 2.5 and 5.2. for urban and rural areas respectively).

These differences in BCRs between the two services and the differences in BCRs for each service between urban and rural settings are possibly due to basic sanitation being generally more expensive to provide than basic water supply (Hutton and Varughese, 2016), while both are more costly in urban areas.

Food and agriculture

Although global food production has kept pace with population growth, close to 750 million people (or 10% of the global population) were exposed to severe levels of food insecurity in 2019 (FAO/IFAD/UNICEF/WFP/WHO, 2020). Unfortunately, this number has increased even further over the course of 2020 due to the COVID-19 pandemic and its economic impacts worldwide.

Rainfed agriculture covers 80% of the world's cropland and accounts for the major part (60%) of food production (Rockström et al., 2007). Rainfed agriculture has a global water footprint of 5,173 km^3 per year (Mekonnen and Hoekstra, 2011a).

Irrigated agriculture covers about 20% of cultivated lands, yet it accounts for 40% of food production (Molden et al., 2010) (Table 5.1), and has a global water footprint of 2,230 km^3 per year (Mekonnen and Hoekstra, 2011a).

The global water footprint related to crop production in the period 1996–2005 was 7,404 km^3 per year, representing 92% of humanity's water footprint (Hoekstra and Mekonnen, 2012).

Despite striking economic growth in the past, there are still 2.1 billion poor people, of whom 767 million people live in extreme poverty. Of all people living in poverty, 80% live in rural areas, where agriculture continues to be the mainstay of their livelihoods (World Bank, 2016b).

Estimates based on comprehensive national and subnational data indicate that 40% of actually irrigated area in the world is serviced by groundwater sources (Siebert et al., 2010).

With proper water accounting and the enforcement of strict withdrawal regulations, the adoption of highly efficient irrigation systems could reduce non-beneficial water consumption at the river basin level with more than 70% while maintaining the current level of crop yields, enabling the reallocation of water to other uses, including environmental restoration (Jägermeyr et al., 2015).

The global economic value of the ecosystem services provided by wetlands only was estimated at US$26 trillion per year in 2011 (Costanza et al., 2014). However, much of the irrigation development worldwide that occurred in the last decades was considered a priority over environmental flows (Jägermeyr et al., 2017).

The full nutrient recovery from wastewater would offset more than 13% of the global demand for these nutrients in agriculture. The recovery of these nutrients could result in a revenue generation of US$13.6 billion globally (Qadir et al., 2020). Beyond the economic gains of reusing wastewater to maintain or improve agricultural productivity, there are critical human health and environmental benefits (FAO, 2010a).

The use of treated wastewater is becoming particularly appealing for agriculture in peri-urban and urban settings. It is estimated that 380 km^3 of wastewater is produced annually across the world, which equals about 15% of agricultural water withdrawals. The irrigation potential of this volume of wastewater stands at 42 million ha (Qadir et al., 2020).

Globally around 14%, in terms of economic value, of the food produced is lost from post-harvest up to, but not including, the retail level (FAO, 2019c). Kummu et al. (2012) found that the global production of lost and wasted food crops accounts for 24% of total freshwater resources used in food crop production.

Sustainable diets are those that are healthy, have a low environmental impact, are affordable and culturally acceptable (FAO, 2010b). Such diets involve a limited consumption of meat, added sugars and highly processed foods, and eating a diversity of plant-based foods (Tilman and Clark, 2014). Shifts towards sustainable diets could also reduce the use of water for food