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The United Nations World Water Development Report 2024

Water for prosperity and peace

Facts, Figures and Action Examples

The state of the world's freshwater resources

Worldwide, agriculture accounts for roughly 70% of freshwater withdrawals, followed by industry (just under 20%) and domestic (or municipal) uses (about 12%).

Groundwater supplies about 25% of all water used for irrigation and half of the freshwater withdrawn for domestic purposes (United Nations, 2022).

Rising demand is primarily driven by a combination of socio-economic development and related changes in consumption patterns, including diet (Zucchinelli et al., 2021), such that the bulk of this increase is located in cities, countries and regions that experience rapid economic development, most notably in emerging economies (Ritchie and Roser, 2017).

Roughly half of the world's population currently experiences severe water scarcity for at least part of the year (IPCC, 2023). While some areas experience water scarcity a few months per year, others endure severe water scarcity year-round.

Water stress has important implications for social stability, and water deficits can be linked to 10% of the increase in migration worldwide (Zaveri et al., 2021).

There is no clear relationship between a country's per capita gross domestic product (GDP) and its water availability.

Per capita water use generally rises as poorer economies develop, led by irrigated agriculture and other water-intensive activities (including municipal water supply and sanitation services), to later drop as economies diversify and eventually level off as economies mature (Duarte et al., 2013; Miglietta et al., 2017). However, if the water embedded in the production of imported goods ('virtual water') is also taken into account, this 'levelling-off' of water use is actually an illusion. Mature economies may outsource water-intensive production processes to developing countries. As such, this alleged 'levelling-off' may actually increase water scarcities in these exporting countries (Hernández et al., 2020).

In low-income countries, an estimated 80% of jobs are water-dependent, primarily due to the dominance of agriculture as the main employment sector (which relies heavily on water). This is notably higher than the estimated 50% of jobs in high-income countries, where the job market is more diversified and less reliant on water sources (Connor and Chaves Pacheco, 2024).

As countries become richer, water pollution does not disappear but evolves (Desbureaux et al., 2022). In lower-income countries, poor ambient water quality is mainly due to low levels of wastewater treatment, whereas in higher-income countries, runoff from agriculture poses the most serious problem. Unfortunately, water quality data remain sparse (United Nations, 2023a).

Emerging contaminants include pharmaceuticals, hormones, industrial chemicals, detergents, cyanotoxins and nanomaterials (Sauvé and Desrosiers, 2014). In a study of 258 of the world's rivers, over a quarter of these were found to have concentrations of active pharmaceutical ingredients that exceeded safe limits (Wilkinson et al., 2022). Whilst the exact effects on human health and biodiversity are not fully known, evidence suggests that this will likely augment antibiotic resistance (WHO, 2014).

Over the period 2002–2021, floods caused nearly 100,000 deaths (with an additional 8,000 in 2022), affected another 1.6 billion people (with another 57 million in 2022) and caused US$832 billion in economic losses (US$45 billion in 2022). Over the same period, droughts affected over 1.4 billion people, killed over 21,000 more and triggered US$170 billion in economic losses (CRED, 2023).

Continued global warming is projected to intensify the global water cycle, and to further increase the frequency and severity of droughts and floods, with more very wet and very dry weather and climate events, and seasons. The incidence of climate-related water- and vector-borne diseases is expected to rise across all regions, and there will be a higher frequency of substantial damages, and increasingly irreversible losses, in freshwater ecosystems (IPCC, 2023).

There is no global repository of data and/or empirical information directly concerning the relationship between water and peace, most likely because the latter is difficult to define, especially when taking account of contributing factors such as equality and justice.

The International Water Event Database, which documents over 6,400 historical international 'water relations' from 1948 to 2008, has shown that a majority of these 'events' have led to more cooperative, rather than more conflictive, outcomes. The Water Conflict Chronology has catalogued over 1,600 events, ranging from direct attacks on pumps and pipeline systems to an "*anonymous threat made to contaminate the water supply with 'biological contaminates' [sic]*" (Pacific Institute, n.d.). The majority of these events are local (sub-national) in nature.

Progress towards SDG 6

With the exception of drinking water and sanitation, deficiencies in monitoring and reporting have made it extremely challenging to generate a comprehensive analysis of most Sustainable Development Goal (SDG) 6 target indicators (United Nations, 2023b).

As of 2022, 2.2 billion people were without access to safely managed drinking water (SDG Target 6.1). Progress between 2015 and 2022 was mainly limited to urban areas, where service provision has been barely keeping up with population growth. Rural areas still accounted for four out of five people lacking at least basic drinking water services in 2022 (UNICEF/WHO, 2023).

The situation with respect to safely managed sanitation (SDG Target 6.2) remains dire, with 3.5 billion people lacking access to such services. Cities and municipalities, in particular, have been unable to keep up with the accelerating growth of their urban populations.

Indeed, "*achieving universal coverage by 2030 will require a substantial increase in current global rates of progress: sixfold for drinking water, fivefold for sanitation and threefold for hygiene*" (United Nations, 2023c, p. 24).

Ambient water quality data (SDG Target 6.3) are not routinely collected in many low- and lower-middle-income countries, meaning that over 3 billion people could be at risk because the health status of their freshwater ecosystems may be below-standards (UNEP, 2021a).

Limited evidence suggests that water use efficiency (SDG Target 6.4) has increased in all economic sectors. In 2020, water use efficiency in agriculture has had the greatest increase (20%) from 2015, followed by the mining, industry, manufacturing, electricity and constructions sectors (13%) (UN-Water, 2019). However, further efforts are required to improve efficiency in irrigated agriculture, the most water-demanding sector (UN-Water, 2021a).

The global average for the implementation of integrated water resources management (SDG Indicator 6.5.1) was 54% in 2020 (UNEP, 2021b). Out of 153 countries sharing transboundary rivers, lakes and aquifers, only 32 have 90% or more of their transboundary waters covered by operational arrangements (SDG Indicator 6.5.2) (UNECE/UNESCO, 2018).

Although surface water available in one fifth of the world's rivers basins changed significantly between 2015 and 2020, the overall extent to which water-related ecosystems have been changing (SDG Target 6.6) remains undetermined (United Nations, 2023c).

Official development assistance disbursements to the water sector (SDG Target 6.a) decreased by 15% (from US$9.6 billion to US$8.1 billion) between 2015 and 2021. Over 85% of countries (105 of 123 responding) had participation procedures defined in laws or policies regarding rural drinking water and water resources management (SDG Target 6.b). However, only 29 of the 117 responding countries reported high or very high participation of communities in planning and management processes for rural drinking water and water resources management (United Nations, 2023b).

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). The benefit–cost ratio (BCR) of such investments has been shown to provide a significant positive return in most regions. One study estimated the BCRs of investments at 3.4 and 6.8 for basic drinking water supply, and 2.5 and 5.2 for basic sanitation, in urban and rural areas respectively (Hutton and Varughese, 2016).

Agriculture and rural development

Agriculture is the largest employer of the world's poor (Townsend et al., 2013). Approximately 80% of the extreme poor live in rural areas and depend on agriculture for their livelihoods and food security (IFAD, 2010). Broad-based rural development and the wide sharing of its benefits are effective means of reducing poverty and food insecurity (United Nations, 2023a) (Box 1).

Food security can be a key driver of peace and prosperity but is also highly vulnerable to disruptions arising from conflicts. It is estimated that between 690 and 783 million people in the world faced hunger in 2022, and it is projected that almost 600 million people will still face hunger in 2030. Worldwide, food insecurity disproportionately affects women and people in rural areas (FAO/IFAD/UNICEF/WFP/WHO, 2023).

Since 1961, the area under irrigation more than doubled, from 139 million ha to over 328 million ha in 2018 (FAO, 2021). About 40% of global agriculture production comes from irrigated land, which is only about 20% of all agricultural land (FAO/OECD 2021).

Irrigation plays a critical role in the transition from subsistence to commercial farming, poverty alleviation and economic growth. Irrigated yields tend to be 30–100% higher compared to adjacent rainfed areas.

More than 3 billion people live in agricultural areas with high or very high levels of water shortages or water scarcity (FAO, 2020). The impacts of climate change are expected to aggravate this situation, with repercussions for agri-food systems and human health, among others.

To feed a projected global population of 10 billion in 2050, agricultural production will need to increase by almost 50% compared to 2012 (FAO, 2017), with much of this growth expected to be achieved through irrigation and water capture and storage, among other soft and hard innovations.

Women are often responsible for balancing household water use to agricultural water needs, and securing water typically falls on women and girls, adding to their unpaid and domestic work burdens.

Action example

Box 1 Addressing small-scale farmers' livelihoods in poverty alleviation

Close to 84% of smallholder farms in low- and middle-income countries are located in water-scarce regions, and less than a third have access to irrigation (Ritchie, 2021; FAO, 2021). There is a need for more attention and help to smallholder farmers and the rural poor, in particular women and children, as the role they play contributes to achieving the Sustainable Development Goals as well as conserving local ecosystems. FAO's framework on extreme rural poverty recognizes that conserving and restoring natural resources should directly benefit the rural poor, particularly those living in remote marginalized areas. This is linked to promoting responsible governance of the tenure of resources. Recognizing the legitimate tenure rights of people to use, manage and control land, water, biodiversity, forests and fisheries is fundamental to helping the rural extreme poor adapt to climate change (FAO, 2019).

By increasing knowledge on the role of water in rural livelihoods and adopting participatory approaches focused on smallholder farmers, actions can be focused to build resilience, identify and adapt water technologies, and promote smart investments in water for poverty reduction. International and national partners are developing methodologies based on the concept of livelihood mapping to help investors and policy-makers in prioritizing, planning and implementing water-related interventions in support of smallholder farmers; performing regional and national studies on rural poverty reduction through water-related interventions; and applying water technologies and approaches to increase the impact of development projects targeting poor farmers, with particular attention to women (FAO, n.d.).

Human settlements

While the wealthiest people generally receive safe water and sanitation at a very low price, the poor often pay much higher prices for unsafe services of much lower quality (WWAP, 2019). Inequality in access to water and sanitation services, while not necessarily a direct driver of conflict, presents significant barriers to socio-economic stability and prosperity.

While the human rights to water and sanitation entitle everyone, without discrimination, to affordable services, in practice, communities in conflict-affected contexts often face discrimination and other barriers, including from public authorities who are ultimately responsible for ensuring access to water and sanitation services (Boxes 2 and 3).

Damage to water infrastructure increases the amount of time women and girls/children – primary collectors of water – are exposed to the threat of violence, also reducing time for education, work and leisure (UN Women/UNDESA, 2022). Survey data from eight countries in Sub-Saharan Africa showed that people from households in areas experiencing internal conflicts over water walked on average 66 minutes to collect water, compared to 30 minutes in areas without such conflict (Pearson et al., 2021). This points to the value of adopting a gender perspective in policies aimed at reducing hardships when safe water supplies are unavailable (UN Women, 2023).

The *Global Report on Internal Displacement 2023* (GRID) revealed that at the end of 2022, the number of internally displaced persons reached its highest level ever recorded, with 71.1 million people displaced worldwide, of which 88% due to conflict and violence (IDMC, 2023).

Year after year, internal disaster-related displacements outnumber conflict-related displacement. Most of this disaster-related displacement is caused by weather-related events linked to water extremes (IDMC, 2022). In the absence of sufficient climate action, the World Bank estimates that, by 2050, 216 million people may be forced to move due to impacts of climate change. Most of these movements are predicted to be within country borders (Clement et al., 2021).

Action example

Box 2 Promoting peaceful cooperation through WASH in South Kordofan (Sudan)

For years, nomadic communities and the settled communities of Kadugli and Reif Shargi had a mutual agreement on the use of water sources. However, in 2021, a deadly clash between nomads and settlers over damage to a water pump led to nomads being banned from using and accessing water. The local authorities and water, sanitation and hygiene (WASH) sector partners launched a joint intervention to build additional water pumps in areas conducive to settler–nomad interaction. Joint WASH committees conduct regular controls and maintenance and intervene when there is any disagreement or conflict at the water points.

Source: UNICEF (Forthcoming).

Industry

Industry uses a significant quantity of water, polluting it and harming ecosystems. At the same time, water availability (i.e. scarcity), quality and accessibility generate risks for industry, exposing it to supply chain disruptions, while climate change multiplies the occurrence and impacts of floods and droughts.

An analysis by Trucost (a division of S&P; Bernick, 2017) found reported water risks of about US$126 billion, which may even become US$439 billion if non-reporting companies are included. The risks came from higher operational costs linked to deteriorating water quality and supply disruption. If companies had to absorb all the costs for decreased water allocations, increased treatment and stronger effluent discharge regulations, average profits could decrease between 18% (chemical sector) and 116% (food and beverage sector).

A 6-year survey of over 16,000 formal firms in over 100 economies found that, in a typical month, an average firm would experience a sales loss of 8.7% for every additional water outage (Damiana et al., 2017).

It has been reported that "*global trends have pointed to a relative decoupling of water – that is, the rate of water resource use is increasing at a rate slower than that of economic growth.*" (UNEP, 2015a, p. 5). This observation is supported by data from the USA, where GDP from 1900 to the mid-1990s grew 20 times whereas water use increased 10 times and declined after 1985 (Gleick, 2002).

The customary linear flow of water in industry, from withdrawal and use to wastewater discharge, does not generally favour reuse and recycling (UNEP, 2015b). However, there are many established technologies for using less (lower withdrawals and consumption) or for reusing and recycling water. Steel production, for example, consumed 200 to 300 tonnes of water per tonne of steel in the 1930s and 1940s, but over time this was reduced to 2 to 3 tonnes (Gleick, 2002).

However, there remains much room for improvement. In one study, only about half the respondents were monitoring their wastewater, and less than a half were monitoring its quality (CDP, 2020).

Switching to renewable energy can reduce both water use and carbon emissions. In the chemical and food and beverage processing industries (in over 100 countries), a 50% increase in renewable energy could result in 60% reduction in water consumption and an even bigger impact on emissions (Bryan et al., 2021).

Nature-based solutions go hand in hand with natural capital and are often used in combination with grey infrastructure. Constructed wetlands are a well-known application that serves to treat certain types of industrial wastewater. They are known for low operation costs related to their long-term performance and low maintenance (Public Services and Procurement Canada, 2019).

Industry's ability to leverage water for prosperity is additionally affected, both positively and negatively, by factors beyond its control. Policies and regulations are significant drivers, often based on financial incentives or command-and-control approaches (i.e. 'carrot and stick').

Water scarcity or pollution frequently drives such confrontational situations where several parties, including industry, require water from limited supplies, leading to competition between unequal parties (Boxes 3 and 4).

Action example

Box 3 Water supply and bribery

Bribery can thrive where water governance is poor. Yet, surveys show that companies that make such payments are more likely to face water shortages. *"The … data show that firms that make an informal payment or gift to obtain a water connection are more likely to face water shortages than firms that do not. Estimates indicate that 26% of firms experiencing water shortages made informal payments to obtain a connection, whereas only 17% of firms that did not experience shortages made such payments."* This suggests that a badly managed water utility may be more open to bribery, and/or that weak governance results in inadequate water service. Either way, some firms need to pay bribes to get water service, which results in the loss of income required for improvements and maintenance of public infrastructure.

Source: Damania et al. (2017, Box 4.1, p. 54).

Action example

Box 4 Examples of disputes over water involving the mining industry in Latin America

In Chile, violent protests over water use that killed three people stopped the Tía María US$1 billion copper mining project in 2011.

In Peru, the projected Minas Conga open pit mine (extending the large Minera Yanacocha gold mine) would affect the people living in Cajamarca, who relied on access to groundwater from alpine lakes for agriculture. Moreover, pollution of the water from the Minera Yanacocha mine was a significant issue. After the government approved the environmental impacts assessment for Minas Conga, the community continuously protested against increasing environmental impacts. The government declared a state of emergency and, in one protest in 2012, tear gas and bullets injured 20 and killed 3 people. Continuing tension and unrest led to the closure of the project in 2016.

The El Mauro tailings dam in Chile is the largest in Latin America. The local indigenous Caimanes community protested because of environmental concerns, using lawsuits, a long hunger strike and road blockages. The court ordered the dam's demolition. Negotiations attempted between the mining company and the community initially met with little progress but in 2016, after more than 10 years, an agreement was reached. This involved a desalination plant to resolve water quality issues, and resettlement compensation and land lease agreements.

Source: CDP (2022) and Oh et al. (2023).

Energy

Achieving SDG 7 – ensuring access to affordable, reliable, sustainable and modern energy for all – will require an acceleration in the uptake of renewable energy (IEA/IRENA/UNSD/World Bank/WHO, 2023). The challenge is to adopt types of renewable energy that also have a low water intensity. Such progress would also directly help achieving SDG 6, especially in areas facing water scarcity or where competition over finite resources between water use sectors could undermine prosperity.

The other side of this connection is that considerable amounts of energy are used to pump, treat and transport water and wastewater, including for irrigation and industry. Achieving universal coverage for both drinking water and electricity involves reducing energy's dependence on water and vice versa, with a view towards lowering greenhouse gas (GHG) emissions.

The data suggest that water use for all types of energy production have been increasing more or less proportionally, with the exception of a notable decrease for fossil fuel-based electricity generation between 2010 and 2016, attributable to a sharp (nearly 20%) decline in coal production over that period (IEA, 2021a).

In terms of electricity generation, the most water-efficient sources are wind and solar-photovoltaic (PV) (WWAP, 2014). Solar PV only requires small amounts of water, for manufacturing and cleaning panels (Stolz et al., 2017). However, it also has the potential to mitigate water loss with other co-benefits when the panels are installed over water (Box 5).

Decarbonizing energy will depend heavily on critical minerals. For example, solar PV needs approximately six times more of these minerals, measured as kg per MW of installed power, than a natural gas plant (IEA, 2022). Additionally, critical minerals frequently need more water and have high eco-toxicity (IEA, 2021b).

The water intensity for biofuels is orders of magnitude higher than for fossil fuels. Irrigated soybean biodiesel, for example, ranges between 10^3 and 10^6 litres per toe (tonne of oil equivalent), whereas conventional oil is roughly between 10^2 and 10^4 litres per toe (IEA, 2016, p. 358, Figure 9.4). Water quality is also a factor, as runoff can carry fertilizers and pesticides (WWAP, 2017).

Desalination is very energy-intensive, accounting for 26% of the energy in the water sector globally (IEA, 2018). In 2018, there were about 16,000 operational desalination plants, of which about half of the total production is located in the Middle East and North Africa region (Jones et al., 2019).

Action example

Box 5 Solar canals – Innovation in the energy–water nexus

Almost ten years ago, a pilot project in Gujarat (India) put solar panels over canals, saving valuable land. There were multiple benefits – evaporation was reduced by shading so that water was saved for other uses, the water cooled the panels and made them more efficient, and the shade reduced algal blooms. One estimate suggested that 2 to 3 MW could be generated per kilometre (Gupta, 2021). A study in California suggested that enough water could be saved for 2 million people if all the 6,400 km of open canals were covered with solar panels, which themselves would generate 13 GW of renewable power (Anderson and Hendricks, 2022). Floating solar panels covering reservoirs could yield similar benefits (Jin et al., 2023), which include hindering weed growth and minimizing land use for new solar installations.

Environment

Ecosystems regulate the amount of water available across space and time, as well as its quality. The economic use value of water from freshwater ecosystems in 2021 was estimated at approximately US$58 trillion, equivalent to 60% of global GDP (WWF, 2023). This includes a total quantifiable direct use value of a minimum of US$7.5 trillion and an additional US$50 trillion annually, 7 times more, from the indirect benefits that are currently chronically undervalued in policies.

Half of the world's GDP is dependent on nature (WEF, 2020).

Over-exploitation of provisioning ecosystem services (food, water, fibre and other raw materials) has impaired the capacity of ecosystems to regulate climate and water, among other benefits. Consequences are potentially disastrous and include disputes over environmental resources and the undermining of sustainable prosperity (Dasgupta, 2021).

Water-related ecosystems are by far the most heavily impacted by poor land management, over-use of water and land conversion (IPBES, 2019). The extent and overall condition of wetlands continues to deteriorate globally (Convention on Wetlands, 2021), although estimates vary widely.

Many European countries have drained most of their peatland wetlands (Joosten et al., 2017). According to one estimate, restoring peatlands could avoid greenhouse gas emissions equivalent to 12–41% of the reductions required to keep global warming below 2°C (Leifeld et al., 2019).

Forests play a major role in the water cycle, through their influence on evaporation/precipitation regimes, regulation of streamflow, and groundwater recharge. About 75% of the world's accessible freshwater comes from forested watersheds (Springgay, 2019).

By 2030, 150 million people a year could need humanitarian assistance due to floods, droughts, and storms and by 2050, this is expected to have risen to 200 million people annually (IFRC, 2019). Implementing nature-based solutions (NbS) could reduce the number of people in need of international humanitarian assistance due to climate change and weather-related disasters.

NbS usually provide multiple benefits, including several related to local prosperity, and are increasingly proving to be cost-effective.

Every dollar invested in ecosystem restoration can create up to US$30 in economic benefits (Ding et al., 2018). Investment in landscape-scale restoration in the USA creates at least twice as many jobs as a similar investment in the oil and gas sector would (Calderón, 2017).

Ecosystem restoration is now recognized as an urgent and key element for conflict resolution and peacebuilding, as well as a tool to improve access to resources, manage climate-related security risks, reduce recruitment by terrorist groups and alleviate pressure on people to migrate (Barbut and Alexander, 2016; UNEP, 2019; United Nations, 2020a) (Boxes 6 and 7).

Strengthening gender equality and women's empowerment related to natural resource management can contribute to building effective and lasting peace (IUCN, 2021) (Box 8).

Lack of information, lack of technical and financial resources, and other capacity gaps hinder the inclusion of diverse values of nature in decision-making, but capacity-building and collaborations among a broad range of societal actors can help bridge these gaps.

Action example

Box 6 The case of human-elephant conflict – Ecosystem degradation, water insecurity and the role of landscape restoration

Human–elephant conflict results from increased space and resource competition as human settlements and agriculture expand. Water security, for both people and elephants, is one root cause of conflicts. Poor land management, particularly vegetation removal, and over-extraction of water lead to dwindling, and increasing variability of, water resources – a situation further exacerbated by climate change. These human-induced changes not only cause reduced agricultural productivity, but also reduce the forage availability for elephants, and the surface water availability for all. Hence competition increases. India alone reports annual deaths of 400 people and 100 elephants during such incidents, with additional direct effects to 500,000 families through crop raiding. Sri Lanka annually documents over 70 human and 200 elephant mortalities from conflict, whilst Kenya reports that 50–120 problem elephants are shot by wildlife authorities each year and about 200 people died in human–elephant conflict between 2010 and 2017. Other Asian and African range countries document similar or worse consequences. Current conflict management approaches focus on prevention through exclusion and on-site deterrents, many of which are nature-based. Examples include the use of spices or bees as deterrents, mitigation via elephant translocation or selective culling and monetary compensation for losses. However, these merely address the symptoms of the problem. Sustainable solutions require site-specific measures to be framed within landscape level restoration planning that addresses patterns of water and vegetation quality and quantity across space and time. Improving landscape productivity and water security underpins long-term promotion of peaceful coexistence between people and nature.

Source: Shaffer et al. (2019).

Action example

Box 7 The Salween Peace Park – An indigenous people-led initiative to promote peace and protect the Salween River basin

The Salween River, crossing China, Myanmar and Thailand, is the longest remaining free-flowing river in Asia. In the Karen state of Myanmar, the rivers of the basin provide valuable services. They also have spiritual value and are sacred to the local indigenous people. The area has suffered over 70 years of conflict, including armed episodes.

Created in 2018 to promote sustainable peace, the Salween Peace Park (SPP) spans over 6,000 km^2 of a highly biodiverse landscape. The SPP is a community-led initiative that empowers local indigenous communities to revitalize their traditional practices, ensure the basin's conservation, and support water management by conserving critical ecosystems.

The SPP is managed sustainably by indigenous Karen communities through an inclusive democratic governance structure that provides spaces for local people to converse on equal footing. The SPP was one of the winners of the 2020 Equator Prize.[a]

This initiative is facing multiple pressures from resource extraction, hydropower development proposals, territorial contentions. Since military action in 2021, displacement and livelihood disruption have stalled community-led management and monitoring activity.

Source: Equator Initiative (2021); Kantar (2019); with inputs from Paul Sein Twa (Salween Peace Park General Assembly/Karen Environmental and Social Action Network (KESAN)).

[a] For more information, please see www.undp.org/press-releases/2020-equator-prize-winners-show-nature-based-solutions-ahead-un-biodiversity-summit.

Transboundary cooperation

Transboundary rivers, lakes and aquifers account for 60% of the world's freshwater flows (UNECE/UNESCO, 2021). Over 310 river basins and an estimated 468 aquifers are shared between two or more countries (McCracken and Wolf, 2019; IGRAC, 2021). A total of 153 countries share rivers, lakes and aquifers.

Transboundary waters globally face significant and increasing pressures due to population increase, growing water demands, ecosystem degradation and climate change. Cooperation over transboundary rivers, lakes and aquifers can generate multiple economic, social, environmental and political benefits that in turn deliver prosperity and peace at local, national, regional and global levels.

While over 3,600 international water treaties have been developed since CE 805 (UNEP/OSU/FAO, 2002) and approximately 120 international basin organizations exist to jointly manage shared basins worldwide (OSU, n.d.), many transboundary water bodies still lack such arrangements. Only 32 out of the 153 countries sharing transboundary waters have at least 90% of their transboundary basin area covered by an operational arrangement for water cooperation (UNECE/UNESCO, 2021), and there are very few aquifer-specific agreements (Burchi, 2018).

Research suggests that "*coordination between stakeholders, through the establishment of institutional capacity in the form of agreements, treaties or informal working relationships, can help reduce the likelihood of conflict. Once institutional capacity is established between parties it has been proven to be resilient over time, even as conflict was being waged over other issues*" (Petersen-Perlman et al., 2017, p. 2).

Inclusive and participatory transboundary water cooperation platforms and processes lead to a common understanding of its objectives and benefits. Indigenous and traditional communities may have long-standing networks across borders. Situating them in the centre of dialogues represents an opportunity for enhancing transboundary cooperation (Box 7).

Across the world, women remain generally underrepresented in the water sector, and in the transboundary water sector specifically (Fauconnier et al., 2018). All scales of water cooperation require the meaningful participation of women, including development and peacebuilding processes, conflict prevention and resolution, and post-conflict reconstruction and recovery (Box 8).

Effective water governance and cooperation support the conjunctive management of both transboundary surface and groundwater resources. Such management should be underpinned by sound data.

With increasingly complex challenges over water access, quality and management and in order to prevent future disputes, flexible arrangements adaptable to changing pressures, particularly measures for climate change adaptation and mitigation, and inclusion of consultation and dispute settlement procedures, will be crucial.

Ultimately, political will is crucial for advancing transboundary water cooperation.

Action example

Box 8 Women's water use association in the Malaka Dam

In Yemen, the water of the Malaka Dam was primarily used by three neighbouring villages for irrigation and livestock, and was a subject of conflict for decades. In an attempt to halt the conflict, a tribal decree was put in place forbidding all use of the dam water. After that, a water use association (WUA) managed by women in the community, Al Malaka, took the lead in dispute resolution and peace negotiation surrounding the dam water usage. WUA members, with support from the Food and Agriculture Organization of the United Nations (FAO), were able to negotiate the implementation of a piping system that would use gravity flow to send the Malaka Dam water to several groundwater wells in the area. This solution was innovative and effective in that it eliminated the need for direct use of the dam water, while it decreased evaporation and rejuvenated well water resources. The water has since been used peacefully for livestock and irrigation in the surrounding areas. This example highlights the need for community involvement and the inclusion of women in matters of water diplomacy in the Arab region.

Regional perspectives

Sub-Saharan Africa

While surface water resources are unevenly distributed, groundwater is relatively abundant throughout most of the region (United Nations, 2022). Most of Sub-Saharan Africa suffers from economic water scarcity, characterized not by the relative level of availability of water resources, but by the lack of appropriate infrastructure, as well as inadequate management and insufficient economic resources and incentives. All these factors hinder lasting progress (UNECA/AU/AfDB, 2003).

Over a third of the countries in Africa – with a combined population of over half a billion (out of a total 1.3 billion) – are considered 'water-insecure' (MacAlister et al., 2023; Oluwasanya et al., 2022). This mirrors Africa's progress towards the SDGs, which has been slow according to most indicators, even regressing in some cases (UN-Water, n.d.).

Since 2015, the number of people without safely managed drinking water in Africa has increased from 703 to 766 million (UN-Water, 2021b), despite the fact that Africa receives one third of global official development assistance (ODA) for the water sector. Capacity to monitor SDG data indicators is generally inadequate, in spite of high-level calls and long-term global efforts to improve data availability (UNECE/UNESCO, 2018).

Factors hindering the prospects for prosperity and peace include: weak institutional arrangements and legal frameworks; insufficient financial arrangements; inadequate data and human capacity; low levels of public awareness and stakeholders participation; and inadequate infrastructure for delivering water for irrigation, domestic and industrial requirements (MacAlister et al., 2023; Oluwasanya et al., 2022; UN-Water, 2021b; UNECA/AU/AfDB, 2003; Van Koppen, 2003).

The vast majority (42 out of 48) of countries in Sub-Saharan Africa share a transboundary basin in the form of rivers, lakes and groundwater aquifers (UNECE/UNESCO, 2018). Africa has the highest proportion of transboundary basins relative to other continents, covering an estimated 64% of the land area (UNECA, 2021).

Transboundary cooperation can broaden the knowledge base, enlarge the range of measures available to mitigate water risk, increase preparedness and recovery for droughts and floods, and offer more cost-effective solutions (UNECA, 2021).

Europe and North America

With 27 out of 42 countries reporting that operational arrangements cover 90% or more of their transboundary river and lake basin area, the Pan-European region represents one of the most advanced regions globally in terms of transboundary water cooperation (UNECE/UNESCO, 2021, p. xii). Such agreements and operational arrangements over transboundary freshwater resources can help promote peace and stability (Box 9).

Across the region, government-established transboundary river basin organizations can act as connectors and active peacemakers by facilitating inclusive dialogue and participatory decision-making. River basin organizations have established mechanisms for multi-stakeholder engagement, giving voice to young people, women and concerned stakeholders.

Action example

Box 9 Post-war recovery: Benefits of transboundary cooperation in the Sava and Drina River basins

The collaborative management of the Sava River basin, shared by Bosnia and Herzegovina, Croatia, Montenegro, Serbia and Slovenia, exemplifies a 'best practice' in transboundary cooperation, resulting in an effective process of socio-economic recovery in the basin through post-conflict cooperation over water (The Economist Intelligence Unit, 2019). The value of this cooperation is still evident today, as countries are jointly tackling emerging issues (notably climate change adaptation, including drought management) and strengthen cross-sectoral cooperation for sustainable planning and policy development, including in the Drina River sub-basin where most of the basin's hydropower is concentrated.

The International Sava River Basin Commission (ISRBC) was established in 2002 with the mandate of implementing the Framework Agreement for the Sava River Basin (FASRB). Remarkably, this was the first regional agreement to be signed since the Dayton Peace Agreement ended the war in the former Yugoslavia. The restoration of inland navigation allowed the return of regional trade, strengthening economic integration across the countries and beyond, notably with the European Union. Rebuilding of bridges and ports throughout the basin accompanied the removal of war debris and mines, leading to the restoration of the local livelihoods, including agriculture and tourism.

In the context of increasing tensions between different major water users, such as agriculture and energy, a participatory assessment of the water–food–energy–ecosystems nexus under the Water Convention was carried out in the Sava[a] (2014) and later in the Drina[b] (2016–2022, through multiple projects) River basin areas. The aim of these assessments was to look for cross-sectoral solutions to increase resource use efficiency, capitalize on regional complementarities, and improve natural resource governance.

These efforts resulted, among others, in the quantification of the benefits of transboundary cooperation on hydropower and the elaboration of possible ways to operationalize flow regulation in the basin (also through the establishment of a dedicated expert group), as part of a 'nexus roadmap' for coordinating actions across sectors and countries. The roadmap aims to coherently guide policy-makers through the implementation of their sectoral and cross-sectoral strategic plans at the basin level (including notably through the Green Action Plan for the Western Balkans – GWP-Med, 2022; n.d.). Climate adaptation, sustainable renewable energy planning and sediment management are among the cross-sectoral activities included in the roadmap and also guide the "Sava and Drina Rivers Corridors Integrated Development Program".[c]

[a] More information on the approach can be found at: https://unece.org/environment-policy/water/areas-work-convention/water-food-energy-ecosystem-nexus.

[b] The Drina Nexus Assessment, along with the Nexus Roadmap and the 'project documents', available at Drina Nexus Assessment – GWP: www.gwp.org/en/GWP-Mediterranean/WE-ACT/Programmes-per-theme/Water-Food-Energy-Nexus/seenexus/drina/.

[c] For more information, please see: www.worldbank.org/en/news/loans-credits/2020/08/06/sava-and-drina-rivers-corridors-integrated-development-program.

Latin America and the Caribbean

Various types of cooperation and coordination mechanisms have led to enhanced water security, sustainable development and peace in Latin America and the Caribbean (LAC). Experiences with transboundary water partnerships, area-based development processes and management of multipurpose dams in the region highlight challenges and lessons learned to reduce tensions among multiple water users.

There are approximately 251 multipurpose dam projects in LAC with diverse uses of hydroelectricity, irrigation, urban supply and/or flood control. This type of infrastructure necessarily implies an intersectoral articulation for their management and coordination between multiple actors. An adequate balance is necessary throughout its entire life cycle to avoid conflicts.

Although hydroelectric energy in LAC represents 45% of electricity (IEA, 2021c), its production is threatened by extreme and varying hydrometeorological events and the growing tensions that arise across users of the basins where they operate. Also, agriculture represents more than 70% of the water use in LAC (UNECLAC, 2023). Therefore, a water–energy–food nexus approach to promote synergies and optimize results in different sectors is needed.

The LAC region has many transnational river basins and aquifers, as well as several multipurpose dams in which partnerships for more sustainable water use are vital for food, energy and water security. The latter are an essential contribution towards socioeconomic development, climate resilience and prosperity.

Asia and the Pacific

The Asia–Pacific region is home to only 36% of the world's water resources (ESCAP, 2021) and about 60% of the world population (United Nations, 2023d), making its per capita water availability the lowest in the world. To compound this fact, overconsumption of water resources was deemed to be the leading cause of water scarcity in the region (ESCAP, 2023).

Asia's irrigation-dependent food baskets in Northwest India and North China are two of the world's top-three hotspots in terms of water-related risks to food production (OECD, 2017). As water scarcity becomes more prevalent in the Asia–Pacific region, governments will be tasked with the difficult challenge of prioritizing water uses across competing water-using sectors.

The region's population living under high or extremely high water scarcity grew from 1.1 billion to over 2.6 billion between 1975 and 2010 (FAO/AWP, 2023).

As the world's most vulnerable region to disasters caused by natural disasters hazards, climate change in the Asia–Pacific is compounding water scarcity and existing shortcomings in disaster response. Asia accounts for nearly one third (31%) of weather-, climate- and water-related disasters reported globally, for nearly half (47%) of deaths, and nearly one third (31%) of associated economic losses (WMO, 2021).

Due to the lack of training resources and appropriate capacities to address the unique challenges of the Pacific Islands, best practice water resource management is often difficult to implement (Box 10).

A global inventory of transboundary aquifers identified 129 shared aquifers in Asia, measuring approximately 9 million km^2, covering about 20% of the entire region.

Currently, over 80% of the countries in the Asia–Pacific region have established a river basin organization to manage water at some scale. However, less than 1% of countries have carried out stakeholder mapping and only one third of countries surveyed have implemented formal or informal mechanisms to engage stakeholders on water-related topics (OECD, 2021). Moreover, only 20% of the countries with river basin organizations have included provisions to protect indigenous and traditional rights (Leckie et al., 2021).

Action example

Box 10 Capacity-building needs in Pacific Island countries

A significant push for increasing water sector capacities will be required to achieve SDG 6 targets in the Pacific. Only 60% of Pacific Islanders have access to basic drinking water and a mere 33% to basic sanitation, with the latter being the lowest rate recorded in the world (UNICEF, 2022). In addition to various governance, poor policy, legislation and ownership issues, a substantial gap in human capacity is also reported. Due to a lack of human capacity in water resource management, existing facilities are not operationally optimized, and an estimated 1,000 out of 8,500 employees in the sector require training on a yearly basis. This finding illustrates the human and financial resource constraints faced by the Pacific Island countries. A perception survey carried out in the Nadi catchment in Fiji found that Pacific Islanders employ traditional community-based approaches to manage water resources. With further training and the right tools, community managers can strengthen existing water resource management (Wilson et al., 2022).

The Arab Region

Cooperation on water at all levels, including transboundary and cross-sectoral, is of crucial importance to the Arab region, one of the most water-scarce regions in the world, with 19 of the 22 states below the water scarcity threshold. Two thirds of the freshwater resources in the region are transboundary, and the 43 transboundary aquifers cover 58% of the area of the region (UNESCWA, 2022).

The Arab region is strongly impacted by conflict. In 2021, seven Arab countries were in conflict, including protracted conflict with wide-ranging implications for water supply and infrastructure and for potential cooperation on water-related issues (UNESCWA, 2023).

Governance

Leveraging water for prosperity and peace requires governance capacity and political will to address water allocation and adaptation challenges across sectors and supply chains, with key roles for a broadening group of actors in government ministries, civil society organizations, and markets (Meinzen-Dick, 2007; Woodhouse and Muller, 2017).

Effective and equitable water allocation encourages investment and benefit-sharing, and ultimately promotes social cohesion.

Joint monitoring and data-sharing serve as a basis for sound cooperation (United Nations, 2023a). Knowledge-sharing can also support informal governance mechanisms, including data-sharing, coordination across sectors, and creative financing mechanisms to share risks and benefits.

Water allocation determines who gets water when, how, and under which conditions. Meeting the basic needs of people is a human right and the top priority among competing uses, followed typically by water for consumptive (food, industry) and non-consumptive (hydropower, recreation) needs.

In many contexts, water allocation policies were developed under a principle of *aqua nullius*. This has excluded indigenous peoples from establishing and enforcing rights, prompting efforts to redress legacies of exclusion (O'Donnell et al., 2023).

Without improvements in water allocation frameworks, economic growth rates have been projected to decline by as much as 6% by 2050 in some regions due to impacts of water shortages on health, agriculture and incomes (World Bank Group, 2016).

The potential for benefit-sharing hinges on investments in governance capacity and water allocation reforms, as well as supporting information about water accounting, water use and water rights. Achieving the potential for benefit-sharing requires investing in governance, not just infrastructure (Schmeier, 2015; Whittington et al., 2013) (Box 11).

Environmental co-benefits (e.g. biodiversity, flood & pollution control) have been shown to motivate partners to engage in more collaborative approaches to water management (United Nations, 2023a) and can therefore help guide and consolidate efforts to coordinate allocation decisions at the river basin level.

Action example

Box 11 Water, energy, and food interdependencies in cities

Cities are facing newly recognized forms of interdependencies between water and related resources. Water, energy and food are key resources for societal flourishing and are strongly interrelated within a system. Taking a water–energy–food (WEF) nexus approach helps to reduce unintended consequences and increase resource security for water and related resources. Singapore and Cape Town provide illustrative examples of such interdependencies. In Singapore, the water sector is heavily energy-dependent, as NEWater (water reuse) and desalination are large components of the nation's water portfolio (Lenouvel et al., 2014). In Cape Town, resource interdependence became evident during the 2018 water crisis, as water allocation was shared between the city and the surrounding agricultural areas. This led to finger-pointing regarding who was to blame for the crisis, instead of proactive coordination across resource sectors and governance scales (Enqvist and Ziervogel, 2019; Jones et al., 2022).

Cities are responding to these interdependencies in various ways. Historically, when Singapore gained independence in 1965, it relied heavily on its neighbour Malaysia for water resources. Given the political tension between the two countries, Singapore made water independence a priority. However, Singapore has limited natural water resources (no natural lakes, no groundwater, and limited streams), requiring innovative approaches to secure their water supply, which in turn required steady, affordable and accessible energy sources (Tortajada and Wong, 2018). Secure energy resources, along with extensive investment in research and development, paved the way for large-scale water reuse and desalination, allowing Singapore to increase its water independence and improve national peace and security by reducing the impact that political tensions with Malaysia could have on its water resources. Looking to the future, Cape Town has developed a Water Strategy, formulating the city-wide priority to achieve water resilience and to become a water-sensitive city. This new strategy involves the direct inclusion of agricultural stakeholders and the consideration of agricultural water use for future water planning (City of Cape Town, 2019).

Singapore and Cape Town provide development pathways for water resources that contribute towards increased adaptive capacity within the water sector and across various sectors for peace and prosperity.

Science, technology and information

A central pillar of informing better technical and management decisions is the availability of accurate data and information (UNESCO/UN-Water, 2020).

Real-time data and information covering relatively short timescales (e.g. minute to hour) are particularly useful for operational decisions such as early warning systems, and for managing infrastructure to mitigate flood risk. Similarly, mid-to-long-term data (e.g. intra- and inter-annual) have provided insights to support the strategic design of water infrastructure and scenario-based planning.

However, there still exists a significant lack of historical and up-to-date data and information on surface and groundwater, soil moisture, and associated hydro-meteorological parameters. Furthermore, historical (time-series) data become less reliable due to increasing climate variability (and change), posing challenges to the planning and design of water infrastructure (IPCC, 2022; Milly et al., 2008).

Government agencies tasked with resource monitoring and management often lack the capacity to collect data and generate information required to address water-related economic and social challenges (United Nations, 2023a). This represents a significant challenge globally (UNESCO/UN-Water, 2020; Cantor et al., 2018; Stewart, 2015).

Data on water quantity and especially water quality remain sparse, due in large part to weak monitoring and reporting capacity. This is especially the case in many low-income countries in Africa and Asia (United Nations, 2023a). It is generally recognized that some of the most data-sparse regions are also the most vulnerable to hydroclimatic hazards (Wilby, 2019). High-altitude regions and fragile states are particularly under-monitored.

Evidence suggests that at high elevation, sites are warming more rapidly than the global average (Pepin et al., 2015). Hydrological assessments are urgently required in mountain regions (Wester et al., 2019; Immerzeel et al., 2010).

There is a need to increase the number of gauging stations, particularly in under-represented basins and environmentally vulnerable areas, to capture the full extent of hydrological variability and anthropogenic influences.

Citizen science represents an invaluable opportunity for both data collection and public participation in water-related projects (Hegarty et al., 2021). Beyond producing data, citizen science is also recognized to have broader environmental, social, economic and political benefits (Hecker et al., 2018). These include strengthening participatory decision-making processes, local leadership and capacity development (Njue et al., 2019).

Forthcoming and transparent sharing of data and information is essential to promote effective water management. However, the level of sharing varies significantly. Data and information can be withheld or manipulated to serve one actor's interest over that of others. There can also be significant time lags between data collection and sharing, which could hamper operational decision-making.

Data-sharing is found to more likely to take place if it responds to a particular operational need and serves practical uses, such as to minimize flood risks or to manage transboundary infrastructure (e.g. a reservoir) between riparians.

Artificial intelligence (AI) has been proposed to help address challenges across water supply, sanitation and hygiene (WASH) systems, water use in agriculture and industry, and water resources management. However, the performance of any AI tool also requires data.

The benefits of AI are caveated with the warning that the impacts of this nascent technology remain largely unknown, with the potential to trigger serious and unexpected problems. These include system-wide compromise owing to design errors, malfunction and cyber-attacks, which in turn could lead to critical infrastructure failure in a worst-case scenario (Box 12).

Water consumption by information technology companies has significantly increased in recent years, by up to a third. A major share of this is attributed to the development of AI and related technologies. Large volumes of water are used in the liquid cooling systems of computers that run AI programmes, in addition to the energy required to power the equipment. The simulated training of GPT-3 in state-of-the-art data centres in the USA consumes an estimated 700,000 l of water (Li et al., 2023).

Action example

Box 12 Risks associated with cyber-attacks

The number of reported cyber-attacks on critical water infrastructure – including drinking water supply, wastewater and sewerage treatment, dams and canals – has increased in recent years (Tuptuk et al., 2021). These risks are expected to rise owing to the development and increasing uptake of cyber-physical water systems, that integrate computational and physical capabilities in order to control and monitor processes. In the past, water system security was achieved largely through physical isolation, limiting access to control components. However, with the emergence of the Internet of Things,[a] water systems are increasingly using a smart systems philosophy, incorporating analytics into industrial control systems to improve the sensing and control capacity (Bello et al., 2023; Tuptuk et al., 2021).

"*Cyber-attacks could be launched remotely by employing command and control techniques to interrupt the system's performance and provide access to illegitimate parties to critical and confidential information. Moreover, in more severe cases, such attacks can even cause physical impairment to the system's structure. Furthermore, such attacks can hamper the water quality by changing the treatment systems or suppressing contamination warnings by affecting water quality sensors*" (Bello et al., 2023, p. 2). The implications on society are potentially serious and multi-faceted.

Cyber-attacks may affect services of critical infrastructure for drinking water, wastewater treatment and sewerage, agricultural production and food systems, energy generation, navigation, and disaster management (including floods and droughts) (Gleick, 2006; Amin et al., 2012; Copeland, 2010).

Governments are developing cyber-security plans to safeguard critical water infrastructure. To mitigate risks, personnel needs to be trained to assess and identify threats to water infrastructure (Bello et al., 2023; Moraitis et al., 2020; Hassanzadeh et al., 2020; Adepu and Mathur, 2016). Measures include regular cyber-security assessments and incident response plans, vigilant monitoring of water system treatment processes, along with access controls encryption, firewalls, anti-virus measures, back-ups and multi-factor authentication (Waterfall, 2023).

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[a] The Internet of things describes devices with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks.

Education and capacity development

Efforts to provide clean water and sanitation for all is falling behind, as the indicators of SDG 6 show clearly (United Nations, 2023b). Education and capacity development are key to addressing this challenge. In many parts of the world, and in many developing countries in particular, water and sanitation are not optimally managed. The lack of training and relevant skill sets is at the heart of this issue (UNESCO, 2014).

This delays the adoption of new technologies for water treatment, sanitation and integrated river basin management, among others – which, in turn, leads to wasteful use of water, avoidable contamination of freshwater resources, and inappropriate levels of access to safe and clean water.

The rapidly increasing pressures on global water resources heighten the risks of competition at various scales in many parts of the world. Avoiding and defusing water-related crises and conflicts will require new ways of thinking, as well as innovative and often transdisciplinary solutions and governance arrangements. Education is the catalyst to uptake and application of such new methods, technologies and behaviours.

Conflict situations can exacerbate the impact on local livelihoods, including education, through water. Reduced access to water and sanitation services resulting from conflict may force children to drop out of school, with often a disproportionate impact on girls.

On the longer term, conflicts may affect the availability of trained experts to provide education and capacity development. Local expertise may disappear through institutional decline, attrition or emigration.

Conflicts may hinder the installation and proper maintenance of monitoring stations and damage existing infrastructure, leading to a lack of relevant data and observations crucial for the adequate design and operation of infrastructure.

Economic and financial skills are necessary to design adequate policies related to water and food security, and to measure the impact of pricing and subsidies. The lack, or improper design and implementation, of economic policies may lead to suboptimal water use and waste. One example is that of perverse subsidies, which often lead to overconsumption and inefficient water use, for example in agriculture (Myers, 1998).

Improving skills and capacity is also key to enable 'bouncing forward' after conflicts or crises. It is a necessary ingredient in order not to return to the status quo, but to use perturbations as an opportunity to build back better, i.e. to improve infrastructure, operation procedures and overall resilience.

Education and capacity-building are key in dispute mediation and resolution. The development of robust, risk-reducing solutions often requires a thorough understanding of local social and cultural contexts, including for example the cultural and religious values of water.

Lack of access to scientific data and evidence, as well as the limited abilities to interpret such evidence, often contributes substantially to a lack of trust between negotiating parties (United Nations, 2023a). In such conditions, open science can support a more transparent evidence generation that has the potential to create trust and make informed and legitimate decisions with active engagement of all stakeholders (UNESCO-IHP, 2022).

About one in six humans, or about 1.2 billion people, are currently aged between 15 and 24. This number is projected to grow by 7% until 2030 (United Nations, 2020b). Youth engagement and education can help nurture a future generation of leaders that are committed to better water stewardship. About half of them are women and girls, who often play a key role as agents of change in water science, culture, and governance. Clear empirical evidence also shows that women participation makes water projects more effective (Van Wijk-Sijbesma, 1998). Therefore, targeting them for quality education and capacity development training is an essential part of the solution to future water security and a resilient society.

Financing water security and mitigating investment risks

Critically, all solutions to the water crisis will require capital, including significant international financial support for the developing world (OECD, 2022).

Considering the vast investment needs for water and sanitation services, particularly in lower- and middle-income countries (LMIC), efforts to increase available capital are a priority. Global costs of achieving SDG 6 are estimated to exceed US$1 trillion per year, or 1.21%[1] of global GDP (Strong et al., 2020).

Based on the user pays principle, tariffs should be the largest and most stable source of sector revenues, to be used for operations and maintenance (O&M) expenditures, as well as for expanding infrastructure, upgrading with more efficient or sustainable technologies, or optimizing service provision. Approaches such as tiered tariffs aim to improve cost recovery whilst also maintaining affordability for low-income users, by providing the lowest rates for consumption, up to a given level, for basic needs (Box 13).

Large-scale investment is needed to achieve SDG 6, and the private sector has an important role to play. While there is increasing interest among private investors, and particularly institutional investors, to grow their sustainable finance portfolios, there are often few financial products that channel their investments towards water (Trémolet et al., 2019).

Development funds can help attract private investment, notably using blended finance approaches that improve the terms for commercial actors through guarantees and grants (OECD, 2018). In 2021, US$ 171 million was mobilized for the water sector with development funds, representing only 1.9% of value of ODA flows to this sector, in the same year (OECD. stat, n.d.).

Green bonds and special purpose vehicles (SPVs) that aggregate smaller water-related investments are emerging. SPVs allow for the grouping of projects that are too small individually to attract finance under a single legal entity, or for the ownership of large projects under a consortium of project sponsors.

A better understanding of water-related risks can make financial actors engage with companies to invest in mitigating those risks. In 2020, the cost of water-related risks to businesses was estimated at US$301 billion, while the cost of mitigating these risks would have been US$55 billion. The financial impacts of water-related risks exceed the costs of inaction in nearly all sectors. Asia and Africa show the greatest cost–benefit potential for such investments (CDP, 2021).

Climate change-resilient infrastructure helps preserve the value of investments and the availability of basic services under conditions of uncertainty (e.g. future demand, resource availability and exposure to environmental risks). It is also a smart financial decision, as protecting assets exposed to hazards in lower- and middle-income countries can provide benefits worth four times their cost (World Bank, 2019).

The private sector and the financial system also play a pivotal role in directing finance towards or away from activities that increase exposure to water-related risks. However, these risks do not seem to be fully understood by central banks. In 2021, only two fifths of surveyed banks had performed a mapping of climate and environment risk exposures (Houben et al., 2021).

Ensuring a water-secure future that supports peace and prosperity requires increasing the quantity and quality of water-related investments, particularly for lower- and middle-income countries that are among the most exposed to risks. To meet the scale of investment needed, both public and private sources of finance are needed.

[1] Based on a 2018 global GDP of US$85.79 trillion.

Action example

Box 13 Targeted water supply subsidies (Chile)

In Chile, a tariff for urban water supply and sanitation was implemented under water reforms in the 1980s. These reforms aimed at recovering the costs of service and led to substantial efficiency gains, but also increased the price of supply delivery.

To address concerns over the affordability of services to low-income households, the government introduced an individual means-tested water consumption subsidy in the early 1990s.

The scheme targeted roughly 20% of the poorest households nationwide, for which the water and sanitation services (WSS) bill constituted over 5% of their monthly income. The subsidy covered 25–85% of the cost of households' basic water consumption (up to 15 m^3 a month) and sewerage, with all consumption beyond this limit charged at the full price. The municipality played a central role in the subsidy scheme, receiving applications, determining eligibility and paying the subsidy directly to the water companies from funding received by the central government (OECD/UNECLAC, 2016).

The combined tiered tariff and subsidy scheme enabled Chile to successfully increase water prices to reflect costs without compromising social and distributional goals. By 2000, the cost of the subsidy scheme reached US$42.5 million. This was significantly lower than the cost of the previous universal subsidy scheme, under which water service providers experienced net financial losses. A financial deficit of 2% of assets in the WSS sector became a surplus of 4% leading to net profits of US$107 million – more than double the subsidy scheme's costs (Leflaive and Hjort, 2020).

The subsidy scheme has since been updated and expanded to broaden coverage to vulnerable groups. A 100% subsidy was also introduced for beneficiaries of the welfare program ('Chile Solidario') designed for very poor households (Contreras et al., 2018).