Science for the Sustainable Development Goals

SDG 6: Clean water and sanitation

Trends in scientific publishing

- In 2020, UNESCO analysed scientific publishing trends for a sample of 56 research topics of particular relevance to eight of the 17 Sustainable Development Goals (SDGs). Data were analysed for 193 countries covering the period 2011–2019. The growth rate was determined by dividing data for 2016–2019 by data for 2012–2015.

- Concerning clean water and sanitation (SDG 6), UNESCO analysed trends in the six fields of: the sustainable withdrawal and supply of freshwater, water harvesting, desalination, wastewater treatment, recycling and re-use, national integrated water resource management and transboundary water resource management.

- The topic of the sustainable withdrawal and supply of freshwater showed the fastest growth among the six SDG-related topics, albeit from a low starting point: from 1 127 (2011) to 2 281 (2019) publications, equivalent to 0.06% of global scientific production between 2011 and 2019.

- Pakistan leads for specialization on this topic, producing 115 (2012–2015) and 171 (2016–2019) publications, over three times the global average intensity. Pakistan Vision 2025 (2013) observes that, ‘with an estimated population of 227 million by 2025, Pakistan’s current water availability of less than 1 100 m³ per person, down from 5 000 m³ in 1951, classifies it as a water-stressed country that is headed towards becoming a water-scarce country if action is not taken urgently’ (see chapter 21).

- Wastewater treatment, recycling and re-use enjoyed the largest volume of output among the six water-related topics under study, with 48 817 publications over 2012–2019 (0.24% of global publications). Low-income countries raised their global share from 0.3% to 0.8% between 2011 and 2019.

- Central Asian countries are publishing twice as much as would be expected on freshwater-related topics, relative to global averages. Regional output on transboundary water resource management is even 38 times the global average proportion (42 publications over 2012–2019), driven by specialization within Kazakhstan and Uzbekistan, which border the shrinking Aral Sea. Of note is that Tajikistan’s output on hydropower (22 publications over 2012–2019) is 17 times the global average proportion; this may relate to the government’s 2014 decision to pursue construction of the Rogun Dam (see chapter 14).

- The Arab region’s research output on desalination grew by 150% from 1 468 (2012–2015) to 2 218 (2016–2019) publications, accounting for 10% of the global total.

- Low-income countries doubled their contribution to global scientific output on transboundary water management from 4.1% to 8.2% and lower middle-income countries from 6.8% to 15.8% between 2011 and 2019.

With climate change exacerbating water scarcity and extreme hydrometeorological events, scientists in the most affected countries are augmenting their output in fields such as transboundary water management, water harvesting, desalination and the sustainable withdrawal and supply of freshwater.
Research trends by income group

For an interactive version of these data, please visit the online data visualization. Publication data by country and selected regions are freely available from the UNESCO Science Report web portal.

**Topic: Sustainable withdrawal and supply of freshwater**

- Scientists produced 12,736 publications on the sustainable withdrawal and supply of freshwater between 2012 and 2019, equivalent to 0.06% of global scientific output.
- China published most over 2016–2019 (2,642), followed by the USA (1,479), India (603) and Australia (467).

**Topic: Water harvesting**

- Scientists produced 4,115 publications on water harvesting between 2012 and 2019, equivalent to 0.02% of global scientific output.
- China produced the largest output on this topic over 2016–2019 with 502 publications. It was followed by the USA (455), India (328), Australia (169), Germany (124) and the UK (105).
- Indonesia showed the fastest growth in output on this topic from 6 (2012–2015) to 48 (2016–2019) publications, with twice the global average intensity of output.
- Among countries with at least 100 publications on this topic during the period under study, China ranked first for growth rate with 183 (2012–2015) and 502 (2016–2019) publications.
**Topic: Desalination**

- Scientists produced 36,126 publications on desalination between 2012 and 2019, equivalent to 0.18% of global scientific output.
- China produced the largest output on this topic over 2016–2019: 5,631 publications. It was followed by the USA (2,979), India (1,252), the Republic of Korea (1,071), Australia (978) and Iran (950).
- Nine Arab States ranked among the top ten countries for specialization on desalination, namely Qatar, Kuwait, United Arab Emirates, Libya, Bahrain, Saudi Arabia, Palestine, Oman and Tunisia.
- Beyond the Arab region, Singapore (9th), Malaysia (13th) and Israel (16th) had the highest specialization in desalination.

**Topic: Wastewater treatment, recycling and re-use**

- Scientists produced 48,817 publications on wastewater treatment, recycling and re-use between 2012 and 2019, equivalent to 0.24% of global scientific output.
- China produced the most publications on this topic over 2016–2019: 8,904. It was followed by the USA (3,522), India (1,733), Spain (1,477), Brazil (1,093), Germany (1,028) and Iran (930).
- Among countries with at least 20 publications on this topic over 2012–2019, Botswana showed the fastest growth from 1 (2012–2015) to 19 (2016–2019) publications. Ecuador (6/51) and Ethiopia (7/50) also showed strong growth.
- Among countries with at least 100 publications on this topic over 2012–2019, Indonesia ranked first for growth rate with 64 (2012–2015) and 411 (2016–2019) publications. The Russian Federation (108/531) and Pakistan (119/348) also recorded strong growth.
- Palestine published nearly five times the global average intensity on this topic (25/28).
Scientists produced 20,151 publications on national integrated water resource management between 2012 and 2019, equivalent to 0.10% of global scientific output.


China produced the most publications on this topic over 2016–2019: 2,731. It was followed by the USA (2,663), the UK (712), Australia (698) and India (577).

Among countries with at least 20 publications on this topic over 2012–2019, Georgia showed the fastest growth from 1 (2012–2015) to 38 (2016–2019) publications. There was also a surge in Costa Rica (4/22), Egypt (60/125), Ethiopia (20/51), Iraq (5/61), Lebanon (4/29) and Nigeria (16/46). Botswana showed the greatest specialization (7/24).

Among countries with at least 100 publications on this topic over 2012–2019, Indonesia ranked first for growth rate (34/144) and South Africa ranked first for specialization (144/276). The following countries at least doubled their output: Sweden (86/175) and Iran (327/684). Israel was one of the rare countries where output declined (72/33).

Scientists produced 864 publications on transboundary water resource management between 2012 and 2019, equivalent to 0.005% of global scientific output.


The USA and China produced the largest output on this topic over 2016–2019 with 94 publications each.

Among countries with at least 15 publications on this topic over 2012–2019, India showed the fastest growth rate with 6 (2012–2015) and 21 (2016–2019) publications. There was also a surge in Brazil (4/13), China (33/94), Mexico (4/12) and South Africa (9/23).

Uzbekistan published over 50 times the global average intensity on transboundary water resource management, producing 7 (2012–2015) and 6 (2016–2019) publications, followed by Kazakhstan with 33 times the global intensity (8/17).

Lower middle-income economies increased their share of global output on this topic from 6.8% to 15.8% and low-income economies from 4.1% to 8.2% between 2011 and 2019 (see Figure 2.8 in the report).
Strategies for sustainable water management

Regional and supranational strategies

- The European Commission’s Horizon Europe proposal in 2018 introduced a mission-oriented programme design expressed through five concrete missions (see chapter 9): adaptation to climate change; cancer; climate-neutral and smart cities; healthy oceans, seas, coastal and inland waters; and soil, health and food.

- Water resources feature among the priority areas for cooperation identified by the BRICS (Brazil, India, China and South Africa) in 2015. The five partners also decided in 2016 to develop the BRICS Networking Platform and Framework Programme for Multilateral STI Projects. The five countries use this platform to launch co-ordinated project tenders. Between 2016 and 2019, eight projects on water resources were supported (see chapter 13).

- There are several points of convergence between the Arab Strategy for Science, Technology and Innovation, endorsed by 22 Arab States in 2014, including Sudan, and Sudan’s Science, Technology and Innovation Policy (2017). Both identify water resources management and the use of nanotechnology in health, the food industry and for the environment as priority areas for collaboration (see chapter 17).

- The African Ministers’ Council on Water (AMCOW) has released a new Strategic Plan 2018–2030 (2018) aligned with the sixth Sustainable Development Goal, in particular. AMCOW’s African Water Facility, which is managed by the African Development Bank (AfDB), had mobilized over €1 billion by 2016 for investment projects in water supply, sanitation, irrigation and hydropower (see chapter 19).

- The agriculture sector remains the largest source of employment in Central Africa. The prospects for agriculture to remain an economic driver in the region remain uncertain, owing to overreliance on rainfed agriculture and agricultural commodity exports. Greater investment in STI to enhance agricultural development figures among the recommendations for fast-track implementation of the commitments under the Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods (2014; see chapters 18 and 19).

  - Agriculture is a key focus of efforts to boost regional integration. The Economic and Monetary Community of Central Africa has adopted the Central Africa Regional Strategy for Risk Prevention, Disaster Management and Adaptation to Climate Change (2016). The strategy lays out plans to fund a satellite and meteorological information centre in Douala for disaster resilience, with support from the AfDB (see chapter 19).
National strategies

- **Dominica**’s National Resilience Development Strategy 2030 has many other aspirations which draw on science and technology, such as: creating green industrial parks; exploiting geothermal and hydroelectric reserves to provide for domestic energy needs and leave a surplus for export; creating a major fisheries processing plant; maintaining an efficient waste management system; ensuring a viable, sustainable and resilient forest; and investing in a safe, affordable and reliable water system (see chapter 6).

- The **Kyrgyz** Academy of Sciences sets its own research priorities. For 2013–2017, these included water and energy, including renewables (see chapter 14).

- **Mongolia**’s Action Programme to 2020 focuses on, *inter alia*, implementing green growth policies to introduce advanced tech-friendly approaches to environmental management and human health, ensure re-use and recycling and place under special state protection no less than 50% of high-value ecosystems offering clean water supplies (see chapter 14).

- Science remains a priority of **Tajikistan**’s National Development Strategy to 2030 (2016), which divides implementation into three five-year phases. On the back of expected economic growth, the strategy aims to reinforce social protection, ensure access to safe food, water supplies and sanitation services, reduce social and gender inequalities and create the conditions for environmental sustainability (see chapter 14).


- In Southern Africa (see chapter 20), climate-smart agricultural practices have risen on the policy agenda following severe episodes of drought or flooding. **Zambia**’s Climate-Smart Agriculture Investment Plan (2019) predicts that climate change could diminish the yields of key crops by 25% but, crucially, that climate-smart agriculture could increase crop yields by 23%.

- The combination of drought and flooding in **Malawi** over the 2015/2016 agricultural season led to the declaration of a State of Disaster. **Malawi**’s National Agricultural Policy (2016) and National Irrigation Policy (2016) together provide a strategic framework for improving productivity, economic diversification and value addition. The Malawi Growth and Development Strategy identifies five key priority areas: agriculture, water and climate change management; education and skills development; energy, industry and tourism development; transport and ICT infrastructure; and health and population.

- Agriculture (mainly rain-fed) employs 90% of the population of **Burundi**, yet only 36% of land is arable. According to the 2018 World Hunger Index, around 15% of the population is living in acute food insecurity. This vulnerability worsens during the long dry season, which is getting drier and hotter. To meet its objectives for food security, the country will need to boost its agricultural productivity, the lowest in the region. This is what the National Agricultural Strategy (2018–2027) and National Agricultural Investment Plan (2018–2022) set out to do. The aim is to facilitate equitable access to arable land and develop and implement policies and programmes to support crop diversification and greater productivity for livestock and fisheries (see chapter 19).

- The government of **Ethiopia** committed 60% of its 2018 budget to poverty-targeted sectors such as education, health, agriculture, water and roads.

- Water, energy and food security is one of six thematic priorities for scientific research defined by **Tunisia**’s Strategic Plan for Scientific Research 2017–2022 (2017) [see chapter 17].
Innovative partnerships and programmes for sustainable water use

- To guarantee safe, clean and well-managed water supplies, the federal government of Canada mandated the Minister of Environment and Climate Change and the Minister of Agriculture and Agri-food in December 2019 to create a Canada Water Agency which will work in conjunction with provinces, territories, indigenous communities, local authorities and scientists (see chapter 4).

- Peru’s Social Innovation Challenges 2016–2019 programme addresses challenges associated with water, among others (see Figure 7.2 in the report).

- Colombia’s National Strategy for Social Appropriation of STI for the Colombian Regions 2012–2018 supports the Ideas for Change programme, which issues calls, selects and funds projects proposing solutions for poor communities, with emphasis on water, energy, ecology and ICTs (see chapter 7).

- In 2019, the Russian Federation implemented joint projects with the Association of Southeast Asian Nations on biological (parasitic) safety and new technologies for industrial water treatment, further to the signing of the ASEAN–Russia Plan of Action on STI to 2025 in 2016 (see chapter 13).

- In Madagascar, where an estimated nine-tenths of the population works in agriculture, the Manitatra 2 project has been promoting organic warm compost, which offers higher yields and improves crops’ resistance to drought and disease. Funded by the EU and implemented by the Groupement Semis Direct Madagascar over the period 2018–2021, the project estimates that it had reached 18,000 Malagasy farmers by August 2020 (see chapter 20).

- Several countries in Southern Africa have experienced severe episodes of drought and flooding since 2015. In 2019, Cyclone Idai caused severe flooding in Madagascar, Malawi, Mozambique and Zimbabwe, for instance. In 2017, UNESCO and the Southern African Development Community (SADC) launched the SADC Water Programme for Building Resilience to Floods and Droughts (see chapter 20).

- The European Union (EU) remains a close scientific partner for many Arab countries. Over 2017–2018, Algeria, Egypt, Jordan, Lebanon, Morocco and Tunisia signed agreements to participate in the EU’s Partnership for Research and Innovation in the Mediterranean Area programme running to 2028. This programme is exploring new approaches to research and innovation in sustainable agriculture production and water availability. The EU is allocating €220 million to the programme, with participating countries providing a further €52 million. This project has been hailed as a major advance in science diplomacy. Six calls for research proposals were launched in February 2020 on water management, the agrifood value chain, the water–ecosystem–food nexus and farming systems (see chapter 17).
Drought has compounded the economic slowdown in Namibia. The 2018/2019 rainy season was one of the driest since 1981, leading to a national water crisis. Namibia’s Water Sector Support Programme has been one response to the crisis. It aims to provide the population with access to sustainable water and sanitation services. A central objective has been to market sanitation and bring about behavioural change. The programme is also building and rehabilitating bulk water infrastructure and climate-resilient sanitation facilities. In March 2020, the AfDB provided a US$ 122 million loan to support the programme, which is due to wind up in 2024 (see chapter 20).

There is limited scientific collaboration in South Asia, where countries are vulnerable to extreme weather events that are being exacerbated by climate change. Afghanistan experienced a severe drought in 2018 and as much as one-third of Bangladesh was flooded in mid-2020 after the heaviest rains in a decade.

– One current project focuses on Integrated Solutions of Water, Energy and Land in the Indus Basin, which is shared by Afghanistan, China, India and Pakistan. Since 2016, this four-year project has designed an inclusive stakeholder process, combined with integrated assessment modelling, to create an evidence-based discussion around critical issues for the region’s future, such as water scarcity. Synergies and trade-offs between the energy, hydro- and agro-economic systems in the basin have been analysed under different climate and development scenarios. One modelling exercise carried out collectively by researchers from the riparian countries concluded that annual investment in the Indus Basin would need to be ramped up to US$ 10 billion, to mitigate water scarcity issues and improve access to resources by 2050. However, these costs could shrink to US$ 2 billion per year, were countries to pursue more collaborative policies. The project is being led by the International Institute of Applied Systems Analysis, in partnership with the United Nations Industrial Development Organization and the Global Environmental Facility (see chapter 21).

– Bangladesh signed a memorandum of understanding with the Japan Development Corporation 2018, focused on improving soil quality at construction sites and the safety of drinking water in arsenic-prone areas (see chapter 21).

– Since 2015, USAID has funded three centres of advanced studies in energy, water and food security at Pakistani universities, at a total cost of about US$ 100 million over five years. The objective is to create ‘islands of excellence’ capable of turning out highly trained professionals, while at the same time solving key development challenges (see chapter 21).
Challenges for sustainable water management

- A number of countries are abandoning hydropower projects as a consequence of unreliable rainfall (e.g. Sri Lanka and Zambia) or safety concerns. Following a report by Brazil’s National Agency for Water and Sanitation in 2018 warning that 45 dams were at a high risk of failure, the government announced the end of megahydropower projects in the Amazon (see chapter 8).

- Plans for a megahydropower plant in the Democratic Republic of Congo have raised concerns about its social and environmental impact. The Grand Inga Dam is a flagship project of the African Union (see chapter 20).

- In 2016, the rising cost of fossil fuel imports, coupled with declining rainfall that made hydropower an unsustainable option, inspired Sri Lanka to launch a community-based project (Soorya Bala Sangramaya, or Battle for Solar Energy) that promotes small rooftop solar power plants for households and businesses through public–private partnerships.

- Countries in East Africa have plans to develop 14 major ports, several international airports and other waterways and lake systems. The latter process will be informed by the Congo–Oubangui–Sangha International Basin Commission co-ordinated by Economic Community of Central African States, which houses a geospatial data collection centre to improve monitoring of navigability on the various regional transboundary waterways (see chapter 19).

- The Lake Chad Basin is a key source of freshwater for more than 45 million people, at the crossroads of Cameroon, Chad, the Central African Republic, Niger and Nigeria. Since 2017, the Biosphere and Heritage of Lake Chad (Biopalt) project has been restoring ecosystems around Lake Chad and fostering the adoption of ‘green’ income-generating activities (see Box 19.4 in the report).

- Madagascar’s rich ecosystems are under threat from rapid deforestation and other forms of land degradation. In recognition of its efforts to restore Lake Andranobe, the community-led organization Tatamo Miray an’Andranobe won the UNDP’s 2020 Equator Prize in the ‘nature for water’ category. This organization formed in 2004 when the lake’s fish stocks were dropping and the watershed shrinking. After enforcing fishery closures and regulating water uptake, fish catches more than doubled over 2014–2019 (see chapter 20).

- By 2025, Antigua and Barbuda plans to increase water desalination by 50% from 2015 levels (see Figure 6.2).

- In March 2018, Caricom countries worked with the Caribbean Community Climate Change Centre to mobilize funds from the Green Climate Fund to support a variety of projects. These include US$ 42.16 million for a Climate-Resilient Water Sector in Grenada and US$ 27.61 million for the Water Sector Resilience Nexus for Sustainability in Barbados (see chapter 6).
In 2016, US$ 80 million was approved for a Sustainable Energy Facility for the Eastern Caribbean, in collaboration with the InterAmerican Development Bank (IADB). This project comes with a Revolving Adaptation Fund Facility to support the installation of irrigation systems and rainwater harvesting systems, as well as water-saving devices for households, public buildings, hotels and farms. The Fund will pursue this work after the project ends.

The Russian Federation has set targets to 2024 for a range of national projects, including those intended to raise the quality of drinking water and restore the ecological potential of reservoirs (see Figure 13.2 in the report).

Kazakhstan plans to use water-saving technologies on 15% of acreage by 2030 (see chapter 14).

In the past few years, Iran has been pursuing programmes more actively to instil policy awareness and acumen in policy-makers to improve decision-making in prioritized areas of science and technology. Such programmes include the national technology foresight programme (2015) for the energy, automotive, health and water sectors (see chapter 15).

In January 2017, the parliament of Iran approved bills mandating the administration to ensure the implementation of strategic environmental assessments and environmental impact assessments, within the framework of the Sixth National Development Plan (2017–2021). The law calls for setting up wastewater treatment plants and conducting water reclamation projects, as well as managing industrial and household wastewater. By 2021, at least 20% of waste is to be disposed of each year in an environmentally friendly way (see Box 15.2 in the report).

For Israel, sustainable development will be vital to overcome its scarce water and land resources. The vast use of reclaimed water has totally re-organized Israel’s water supply and sanitation sector (see Box 16.3 in the report). In 2019, some 86% of wastewater was re-used in agriculture. One emerging concern being investigated is the potential influence of contaminants such as pharmaceutical drugs and hormones on public health. These contaminants are not completely eliminated by wastewater treatment plants and might spread to crops and other agricultural products through irrigation. Desalination now provides 70% of domestic and municipal water. It is causing challenges such as saltwater intrusion in aquifers and agriculture and, among citizens who drink only desalinated water, a magnesium deficit which has been associated with heart disease.

Water scarcity, soil erosion and environmental degradation all present serious challenges for the Arab region (see chapter 17).

– The United Arab Emirates is experimenting with indoor vertical farming, which uses non-soil substrates to limit water use and artificial lighting. About 97% of groundwater is currently used for agriculture in this country, even though much of this is ‘fossil’ water left over from an earlier, wetter climate that is not being replenished. In all, 89 hydroponic projects were active as of early 2020 (see chapter 17).
– In Qatar, groundwater is being extracted at nearly four times the rate at which it is naturally replenished. With no surface freshwater, desalination provides 99% of the country’s potable water. In order to expand water reserves, the Qatar General Electricity and Water Corporation inaugurated the Water Security Mega Reservoirs project in December 2018. It has expanded total water storage capacity by 67%. Its 15 concrete reservoirs are the world’s largest potable water storage tanks; they are expected to cover storage requirements until 2026 (see chapter 17).

– Access to clean drinking water has improved in Mauritania since 2015, with 72% of urban and 53% of rural populations benefitting by 2018. However, huge disparities remain, with only around 34% of the poorer segment of society having access (Govt of Mauritania, 2019). As of 2018, more than 20 water and sanitation projects were being implemented at a total estimated cost of US$ 542 million, funded both from the national budget and from external sources (Govt of Mauritania, 2019). Related research is being conducted at the World Bank-funded National Centre for Water Resources (see chapter 17).

– Saudi Arabia is the largest producer of desalinated water in the world. It aims to hoist production from 60% to 90% of urban needs by 2030. Desalination is a costly process and many plants operate using energy derived from fossil fuels. In 2015, Advanced Water Technology, the commercial arm of the King Abdulaziz City for Science and Technology, partnered with the Spanish firm Abengoa to build one of the world’s first large-scale solar-powered desalination plants near Al Khafji City. Inaugurated in November 2018, the plant can treat 60 000 m³ of seawater per day (see chapter 17).

– The Ghana Astronomical Project completed the conversion of an abandoned communication satellite in the town of Kuntunse into a radio astronomical telescope in 2017. This telescope is being used to monitor agriculture, biodiversity, land-use changes and water resources, among other things. The Kuntunse telescope is part of the Square Kilometre Array project led by South Africa (see Box 18.3 in the report).

– In Botswana, researchers have been tackling the problem of the invasive water fern, Salvinia molesta, which has been threatening the Okavango Delta, a UNESCO World Heritage site and Africa’s largest wetland, for the past three decades. Thanks to the introduction of a Salvinia-munching weevil in 2002 as an alternative to chemical pesticides, the invasion was brought under control in 2016.

– In February 2020, Turkey approved the zoning plan for construction of a shipping canal, in order to bypass Istanbul’s busy Bosporus Strait. The project has raised concerns about the potentially severe environmental impact on the fragile ecosystems of the Marmara Sea and the inshore lagoons and lakes which supply Istanbul’s 16 million inhabitants with freshwater (see chapter 12).

– In coastal regions and rural areas vulnerable to flooding and other climate-related hazards, the Bangladesh Ministry of Disaster Management and Relief has constructed bridges and culverts and procured a saline water treatment plant to mitigate disaster risk (see chapter 21).

– Some 80% of land in the Maldives is less than 1 m above sea level and 42% of the population and more than 70% of critical infrastructure is situated within 100 m of the shoreline. In 2016, over 45 islands faced water shortages during the hottest dry season recorded in 18 years. The government is developing food and water storage on inhabited islands to prepare for the extreme events to come (see Table 21.1 in the report).

– Within Singapore’s ‘whole of nation’ approach, infrastructure development is intended to have both social and environmental benefits, such as the deep tunnel wastewater system that will shrink the land occupied by wastewater infrastructure by half and facilitate efficient, large-scale water recycling. As Singapore expects the share of non-domestic water use to rise to 70% by 2060, the government has also recognized the need to work across sectors to reduce consumption (see chapter 26).
Research and training in water science

- Two Earth observation satellites developed by the Argentine space agency CONAE with fellow agencies were launched in 2018 and 2020 as part of a constellation that will provide real-time information to monitor soil moisture, plagues of agricultural pests, outbreaks of dengue and Zika, forest fires and climate change, among other applications. The manufacture of local parts for the project has spawned a network of 1,500 high-tech SMEs in Argentina (see chapter 7).

- In 2018, Armenia published its first Satellite Water Account System, which provides comprehensive data on the extent and use of existing water resources (see chapter 12).

- Over 2017–2018, Algeria, Egypt, Jordan, Lebanon, Morocco and Tunisia signed agreements to participate in the EU’s Partnership for Research and Innovation in the Mediterranean Area (PRIMA) programme running to 2028. This programme is exploring new approaches to research and innovation in sustainable agriculture production and water availability. The EU is allocating €220 million to the programme, with participating countries providing a further €52 million. This project has been hailed as a major advance in science diplomacy. Six calls for research proposals were launched in February 2020 on water management, the agrifood value chain, the water–ecosystem–food nexus and farming systems (see chapter 17).

- Water scarcity, soil erosion and environmental degradation all present serious challenges for the Arab States. For example, the United Arab Emirates is experimenting with indoor vertical farming, which uses non-soil substrates to limit water use and artificial lighting. About 97% of groundwater is currently used for agriculture. In April 2020, the Abu Dhabi Investment Office, a government body founded in 2018 to support start-ups and SMEs, announced plans to allocate US$100 million to four agritech firms as an initial investment in a larger US$272 million programme in support of agritech. The four firms are developing an indoor tomato farm (Masdar Farms); a research centre (Aerofarms); an irrigation system compatible with sandy soil; and more efficient fertilizers.

- The Economic Community of West African States (ECOWAS) has partnered with the German government to create the West African Science Service Centre on Climate Change and Adapted Land Use, which encompasses a Climate Research Programme, a Graduate Studies Programme and observation networks. Among the doctoral programmes proposed by universities in participating countries, that in climate change and water resources is dispensed by the University of Abomey-Calavi University in Cotonou, Benin (see Box 18.1 in the report).

- Since 2014, the World Bank has supported the Africa Higher Education Centres of Excellence programme, including the International Institute of Water and Environmental Engineering (2iE) in Burkina Faso, which focuses on water, energy, environmental sciences and technologies, and a centre on water and environmental sanitation at Kwame Nkrumah University of Science and Technology in Ghana (see Table 18.1 in the report).

- The World Bank has extended the Centres of Excellence Programme to East Africa. Since 2017, there has been a centre specializing in water management at Addis Ababa University in Ethiopia (see Table 19.4 in the report).

- In Angola, researcher density is insufficient to meet development needs (see Figure 20.5 in the report). To address this shortage, UNESCO and the Ministry of Higher Education, Science, Technology and Innovation launched a national doctoral training programme in 2019 with a budget of US$50 million to train 160 candidates in environment, water, energy, digital technologies, life sciences, natural resources management and marine resources management (see chapter 20).

- In China, the government has established a big data platform to monitor water quality, within one of the 16 mega-engineering programmes established under the Outline of the Medium and Long-Term Plan for the Development of Science and Technology (2006–2020). Scientists have developed a number of core technologies and equipment to treat water pollution that have been deployed in the Beijing–Tianjin–Hebei region and Taihu Lake Basin. Between 2015 and 2018, the ratio of major rivers and lakes complying with water quality standards reached 77% (see chapter 23).

Assessing the state of the world’s water

UNESCO established the World Water Assessment Programme (WWAP) in 2000 in response to a call from the United Nations Commission on Sustainable Development to produce periodic global overview of the status in terms of quantity and quality, use and management of freshwater resources.


The WWAP Toolkit on Sex-disaggregated Water Data (second edition, 2019) offers a global standard for the collection of sex-disaggregated water data through a unique set of gender-responsive indicators. WWAP runs workshops to help countries apply this universal methodology as a basis for a gender-transformative approach to water monitoring and assessment. In August 2021, WWAP launched a co-ordinated global Call for Action for Accelerating gender equality in the water domain.

For details, see: https://en.unesco.org/wwap

Accelerating progress towards SDG6

UNESCO’s Intergovernmental Hydrological Programme (IHP) dates from 1975. Its 169 national committees establish a new scientific programme every eight years.

Between 2018 and 2021, the IHP helped 44 countries to enhance their resilience to climate change, water-related hazards and water scarcity. Many beneficiaries are in Africa. For instance, scientists from the IHP have developed satellite observation systems to monitor the quality and quantity of water in Lake Chad and establish early warning systems for flooding and drought in the basin (see photo on p.9 of this policy brief).

One focus is nature-based solutions. The IHP’s ecohydrology programme operates in 18 countries through 23 demonstration sites which include wetlands, rivers, lakes, cities and reservoirs.

Since the world is not on track to reach SDG6 on clean water and sanitation, UNESCO is co-ordinating the UN-Water SDG 6 Capacity Development Initiative with the United Nations Department of Economic and Social Affairs to bolster national capacity for freshwater management. UNESCO is also part of the Water and Climate Coalition co-ordinated by the World Meteorological Organization.

For details, see: https://en.unesco.org/themes/water-security/hydrology