Food and Agriculture
Organization of the
United Nations

Progress on change in water-use efficiency

GLOBAL STATUS AND ACCELERATION NEEDS FOR SDG INDICATOR 6.4.1

2021

United Nations | UN WATER

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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MAPS:

Final boundary between the Sudan and South Sudan has not yet been determined.
Final status of the Abyei area is not yet determined.
Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

Presenting the UN-Water Integrated Monitoring Initiative for SDG 6

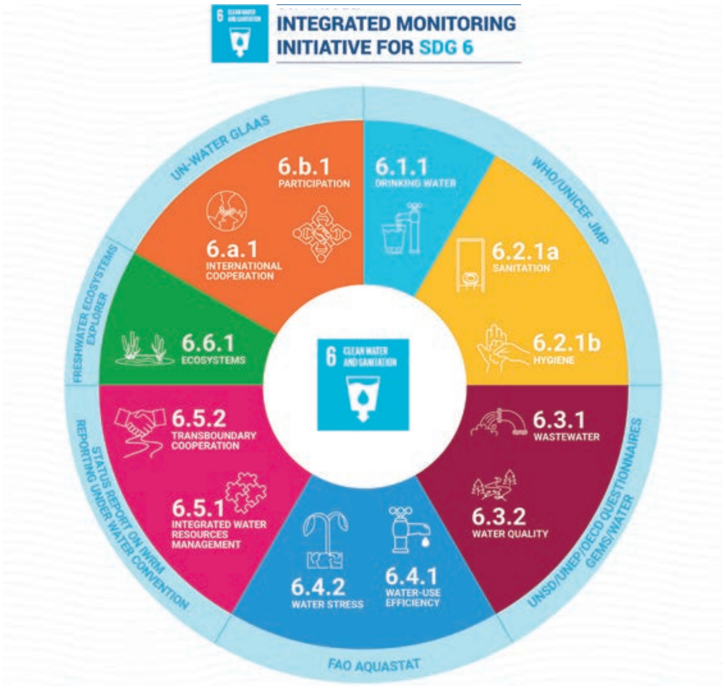
Through the UN-Water Integrated Monitoring Initiative for SDG 6 (IMI-SDG6), the United Nations seeks to support countries in monitoring water- and sanitation-related issues within the framework of the 2030 Agenda for Sustainable Development, and in compiling country data to report on global progress towards SDG 6.

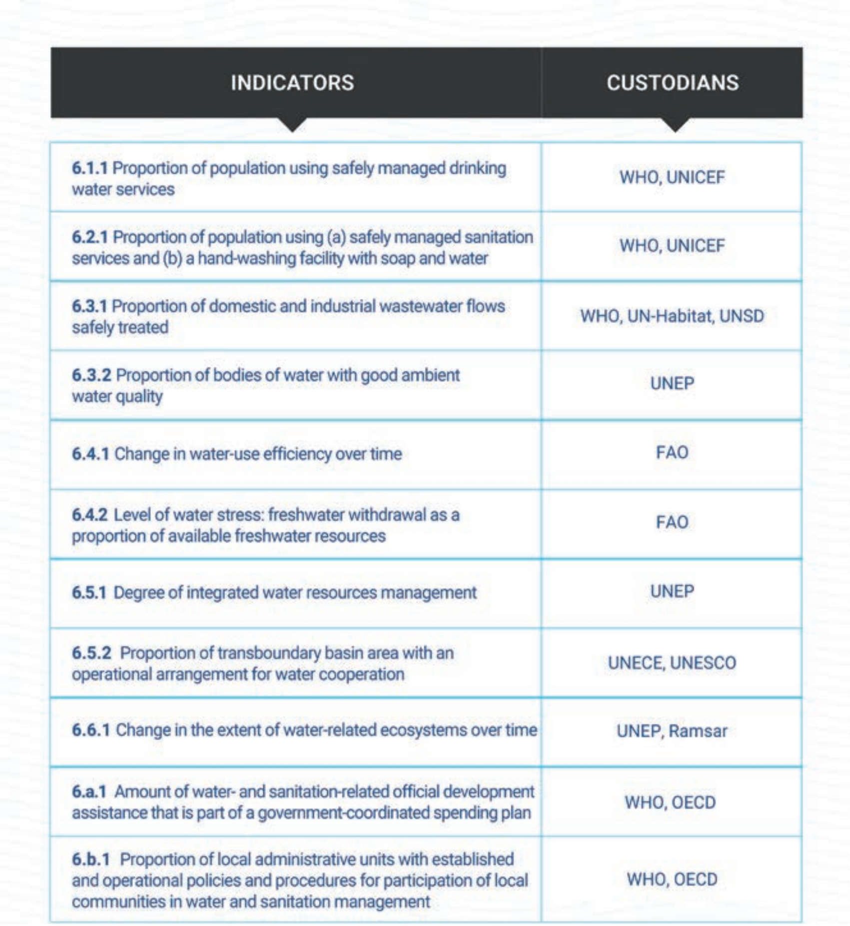
IMI-SDG6 brings together the United Nations organizations that are formally mandated to compile country data on the SDG 6 global indicators, and builds on ongoing efforts such as the World Health Organization (WHO)/United Nations Children's Fund (UNICEF) Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP), the Global Environment Monitoring System for Freshwater (GEMS/Water), the Food and Agriculture Organization of the United Nations (FAO) Global Information System on Water and Agriculture (AQUASTAT) and the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS).

This joint effort enables synergies to be created across United Nations organizations and methodologies and requests for data to be harmonized, leading to more efficient outreach and a reduced reporting burden. At the national level, IMI-SDG6 also promotes intersectoral collaboration and consolidation of existing capacities and data across organizations.

The overarching goal of IMI-SDG6 is to accelerate the achievement of SDG 6 by increasing the availability of high-quality data for evidence-based policymaking, regulations, planning and investments at all levels. More specifically, IMI-SDG6 aims to support countries to collect, analyse and report SDG 6 data, and to support policymakers and decision makers at all levels to use these data.

- Learn more about SDG 6 monitoring and reporting and the support available: www.sdg6monitoring.org
- Read the latest SDG 6 progress reports, for the whole goal and by indicator: https://www.unwater.org/publication_categories/sdg6-progress-reports/
- Explore the latest SDG 6 data at the global, regional and national levels: www.sdg6data.org





INDICATORS	CUSTODIANS
6.1.1 Proportion of population using safely managed drinking water services	WHO, UNICEF
6.2.1 Proportion of population using (a) safely managed sanitation services and (b) a hand-washing facility with soap and water	WHO, UNICEF
6.3.1 Proportion of domestic and industrial wastewater flows safely treated	WHO, UN-Habitat, UNSD
6.3.2 Proportion of bodies of water with good ambient water quality	UNEP
6.4.1 Change in water-use efficiency over time	FAO
6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	FAO
6.5.1 Degree of integrated water resources management	UNEP
6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation	UNECE, UNESCO
6.6.1 Change in the extent of water-related ecosystems over time	UNEP, Ramsar
6.a.1 Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan	WHO, OECD
6.b.1 Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management	WHO, OECD

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Foreword

The 2030 Agenda for Sustainable Development stresses the importance of “leaving no one behind”. This can only be achieved if the interlinkages between its 17 SDGs are adequately articulated and appropriate actions are undertaken to bring them together for the benefit of all.

The Food and Agriculture Organization of the United Nations (FAO) is supporting the 2030 Agenda through the transformation to MORE efficient, inclusive, resilient and sustainable agri-food systems for better production, better nutrition, a better environment, and a better life - leaving no one behind. The transformation of agri-food systems is at the heart of FAO’s mandate and at the core of FAO’s Strategic Framework 2022-2031.

Water is the essence of life and at the core of the agri-food systems. The path to water efficiency passes through sustainable agri-food systems. This report shows the progress in the monitoring of indicator 6.4.1 "Change in water-use efficiency over time" for which FAO is custodian, in the context of the Sustainable Development Goals (SDGs) global report. It reveals that there is opportunity to further increase water-use efficiency in all sectors, including agriculture, the world largest water user. It also identifies recommendations for acceleration towards the achievement of the SDG target of sustainable water use.

Water productivity gains, good governance and a coordinated holistic policy framework are major entry points for actions needed to address water challenges in agri-food systems. Better knowledge of water resources and their use and management, innovation and capacity building are fundamental in order to develop instruments for defining and implementing appropriate policies.

FAO joined the Integrated Monitoring Initiative for SDG6 (“Clean Water and Sanitation”) in 2015, coordinated by UN-Water, which has gathered experiences and resources aimed at ensuring a coherent monitoring framework for water and sanitation by 2030. Such a framework will help countries achieve progress through well-informed decision-making on water, based on harmonized, comprehensive, timely and accurate information.

FAO, predominantly through its AQUASTAT database, remains committed to improving the quality and quantity of data produced and analysed, in close partnership with the relevant national authorities of our Members. In coordination and collaboration with other stakeholders, FAO will continue supporting Members to achieve this target by providing scientific and technical assistance.

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Qu Dongyu

FAO Director-General

Foreword

The COVID-19 crisis has caused enormous disruption to sustainable development. However, even before the pandemic, the world was seriously off track to meet Sustainable Development Goal 6 (SDG 6) – to ensure water and sanitation for all by 2030.

No matter how significant the challenges we face, achieving SDG 6 is critical to the overarching aim of the 2030 Agenda, which is to eradicate extreme poverty and create a better and more sustainable world. Making sure that there is water and sanitation for all people, for all purposes, by 2030 will help protect global society against many and varied looming threats.

Our immediate, shared task is to establish safe water and sanitation services in all homes, schools, workplaces and health care facilities. We must increase investment in water use efficiency, wastewater treatment and reuse, while protecting water-related ecosystems. And we must integrate our approaches, with improved governance and coordination across sectors and geographical borders.

In short, we need to do much more, and do it much more quickly. In the SDG 6 Summary Progress Update 2021 that preceded this series of reports, UN-Water showed that the current rate of progress needs to double - and in some cases quadruple - to reach many of the targets under SDG 6.

At the March 2021 high-level meeting on the "Implementation of the Water-related Goals and Targets of the 2030 Agenda", UN Member States noted that to achieve SDG 6 by 2030 will require mobilizing an additional USD$ 1.7 trillion, three times more than the current level of investment in water-related infrastructure. To make this happen, Member States are calling for new partnerships between governments and a diverse group of stakeholders, including the private sector and philanthropic organizations, as well as the wide dissemination of innovative technology and methods.

We know where we need to go, and data will help light the way. As we ramp up our efforts and target them at areas of greatest need, information and evidence will be of critical importance.

Published by the UN-Water Integrated Monitoring Initiative for SDG 6 (IMI-SDG6), this series of indicator reports is based on the latest available country data, compiled and verified by the custodian United Nations agencies, and sometimes complemented by data from other sources.

The data were collected in 2020, a year in which the pandemic forced country focal points and UN agencies to collaborate in new ways. Together we learned valuable lessons on how to build monitoring capacity and how to involve more people, in more countries, in these activities.

The output of IMI-SDG6 makes an important contribution to improving data and information, one of the five accelerators in the SDG 6 Global Acceleration Framework launched last year.

With these reports, our intention is to provide decision-makers with reliable and up-to-date evidence on where acceleration is most needed, so as to ensure the greatest possible gains. This evidence is also vital to ensure accountability and build public, political and private sector support for investment.

Thank you for reading this document and for joining this critical effort. Everyone has a role to play. When governments, civil society, business, academia and development aid agencies pull together dramatic gains are possible in water and sanitation. To deliver them, it will be essential to scale up this cooperation across countries and regions.

The COVID-19 pandemic reminds us of our shared vulnerability and common destiny. Let us "build back better" by ensuring water and sanitation for all by 2030.

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Gilbert F. Houngbo

UN-Water Chair and President
of the International Fund for
Agricultural Development

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List of acronyms and abbreviations

A_{we}	Irrigated agriculture water-use efficiency [USD/m^3]
C_r	Proportion of agricultural gross value added produced by rainfed agriculture
CWUE	Change in water-use efficiency
GDP	Gross domestic product
GVA	Gross value added (for all sectors)
GVA_a	Gross value added by agriculture (excluding river and marine fisheries and forestry) [USD]
GVA_{aa}	Gross value added of the freshwater aquaculture subsector [USD]
GVA_{ai}	Gross value added of the irrigated cultivations subsector [USD]
GVA_{al}	Gross value added of the livestock subsector [USD]
GVA_{a-rev}	Gross value added by agriculture without the rainfed subsector
GVA_m	Gross value added by MIMEC (including energy) [USD]
GVA_s	Gross value added by services from ISIC sectors E and G to T [USD]
IFAD	International Fund for Agricultural Development
ISIC	International Standard Industrial Classification of All Economic Activities
IWMI	International Water Management Institute
IWRM	Integrated water resources management
JMP	Joint Monitoring Programme for Water Supply and Sanitation
LEAP	Livestock Environmental Assessment and Performance Partnership
MDG	Millennium Development Goal
M_{we}	MIMEC water-use efficiency [USD/m^3]

MIMEC	Mining and quarrying, manufacturing, constructions and energy
OECD	Organisation for Economic Co-operation and Development
P_A	Proportion of water used by the agricultural sector over the total use
P_M	Proportion of water used by the MIMEC sector over the total use
P_S	Proportion of water used by the service sector over the total use
SDG	Sustainable Development Goal
SEEA-Water	System of Environmental-Economic Accounting for Water
SNA	System of National Accounts
S_{we}	Services water-use efficiency [USD/m^3]
SWOT	Strengths, weaknesses, opportunities and threats
UNICEF	United Nations Children's Fund
UNSD	United Nations Statistics Division
V_a	Volume of water used by the agricultural sector
V_m	Volume of water used by MIMEC (including energy)
V_s	Volume of water used by the service sector
WFP	World Food Programme
WHO	World Health Organization
WUE	Water-use efficiency [USD/m^3]

Executive summary

Water-use efficiency rose from 17.3 USD/m^3 in 2015 to 18.9 USD/m^3 in 2018 worldwide, representing a 9 percent efficiency increase. The proportion of countries generating water-use efficiency results over the global value for each year varied from 45 percent in 2015 to 46 percent in 2018. All economic sectors have seen an increase in their water-use efficiency since 2015. In 2018, the industrial sector had a water-use efficiency equivalent to 32.2 USD/m^3, the services sector 112.2 USD/m^3 and the agriculture sector 0.60 USD/m^3. Compared with 2015, this represents an increase of 15 percent in the industrial sector, 8 percent in the services sector and 8 percent in the agriculture sector. These results were produced using data available from 166 countries for 2015–2018 and can provide an overall picture of the change in water-use efficiency globally.

To analyse whether economic growth is decoupled from water use requires complete data sets. Although global information was available from 2015, only long time series without imputed data can provide an overview of changes in economic dynamics in relation to the water used, meaning the 2015–2018 period falls short. Overall, 86 countries had regularly reported water-use data since 2006, which were used to obtain a reliable longer-term perspective of the dependency of economic growth on water use. These 86 countries represent approximately 56 percent of the 2018 world population.

The three major sectors of these 86 countries increased their water-use efficiency over time, with agriculture increasing from 0.5 USD/m^3 to 0.8 USD/m^3, industry from 18.5 USD/m^3 to 31 USD/m^3 and services from 104 USD/m^3 to 135.9 USD/m^3. This means that the industrial sector has experienced the largest net efficiency gains from 2006 to 2018, likely due to the transformation of thermal cooling for energy production, industrial processes and heating systems. This reflects the important reduction in water withdrawals within these countries' industrial sectors, which has also occurred at the global level (though the level of withdrawal is more significant in the selected 86 countries due to their type of economy, with industry contributing more to overall gross value added (GVA) than in other countries).

Dependency between water use and GVA in the agriculture and services sectors appears to be a continuing trend. Within the industrial sector, however, water use has been reduced drastically for the generation of value added, meaning increased water-use efficiency. An analysis of how total withdrawals relate to GVA over the years reveals a potential decoupling of economic growth from water use since 2016. Nonetheless, these results are preliminary, and it is therefore too early for a solid conclusion to be made. The fact that there are only three data points, which show a new trend, is not conclusive. In addition, the industrial weight in these countries influences the overall calculation. This issue will be further analysed in the next reporting periods when more data are available.

Data availability and accuracy are crucial for the computation of indicator 6.4.1. More data need to be collected, ideally on an annual basis, to compute the indicator at the global level and for the various economic sectors, and also to observe any regional differences.

> **The main challenge for this indicator is therefore obtaining enough information to demonstrate increases in value added per unit of water withdrawn, especially in the poorest regions.**

This indicator does not aim to provide an exhaustive picture of a country's water utilization. To provide adequate follow-up of target 6.4, the indicator needs to be combined with indicator 6.4.2 on water stress. Furthermore, the use of supplementary indicators at the country level, including the monitoring of irrigation, water distribution networks and industrial and energy cooling efficiencies, would enhance the interpretation of this indicator.

Rhodope Mountains, Bulgaria by Gery Pav ©Unsplash

Key messages and recommendations

- The two indicators included in the monitoring process of target 6.4 are complementary. Indicator 6.4.1 is an economic indicator, assessing the extent to which a country's economic growth is dependent on the use of water resources, while indicator 6.4.2 is an environmental indicator, tracking the physical availability of freshwater resources and the impact of water use.
- Promoting water-use efficiency is important, particularly in water-scarce areas.
- Trade can play a role in increasing a country's water-use efficiency by supporting higher value water uses. Virtual water exchanges should be considered to account properly for the country's water needs.
- Water scarcity should not become a constraint to economic growth. For countries with medium to high water stress, increasing water-use efficiency is needed to ensure that water scarcity does not limit their capacity to grow, both economically and socially.
- However, in most cases, devising policies that aim to move water from one economic sector to another to increase the value of water-use efficiency would be ineffective, as it could create distortions and trade-offs that impact food security or sanitation, which are likely to be signalled by other Sustainable Development Goals (SDG) indicators.
- Water-use efficiency should be pursued in all sectors. Decoupling economic growth and water use means that a given marginal increase of national income does not correspond to an equivalent or higher marginal increase in water use, i.e. economic growth does not imply using more water.
- Increasing water-use efficiency is a complex exercise that involves coordination and collaboration among several institutions and stakeholders in a country. The process of implementing integrated water resources management (IWRM; assessed by SDG indicator 6.5.1) supports this coordination and stakeholder participation, which can benefit from the information provided by target 6.4 indicators.
- The improvement of human skills, technological advancements and the ongoing maintenance of equipment and systems are just some of the issues that must be taken into account to reduce the dependency of a country's economic and social life from a growing use of water resources.

- Agriculture is the largest water user, as well as the sector with the lowest GVA aggregate. Reducing the amount of water needed for irrigation can play an important role in increasing countries' overall water-use efficiency. Increased water-use efficiency in agriculture would release water resources for use elsewhere, such as for environmental needs or in other more profitable sectors. A balance between food security, sustainable water use, and economic growth must be sought.
- Although the social value of water is not quantified, it must not be underestimated. Conflicts should be avoided between domestic and economic use of water resources, particularly in relation to agriculture, by developing tools and mechanisms that enable the equitable allocation of water resources.

Dried up lake in Sabba, Burkina Faso by Yoda Adaman ©Unsplash

Pogradec, Albania by Endri Killo ©Unsplash

1. Introduction and background

1.1. The 2030 Agenda for Sustainable Development

In September 2015, Heads of State from around the world adopted the 2030 Agenda for Sustainable Development, comprising 17 Sustainable Development Goals (SDGs) with 169 targets. All SDGs are interlinked, since transitioning towards more sustainable and resilient societies requires an integrated approach. The 2030 Agenda includes a goal on water and sanitation (SDG 6), which sets out to "ensure availability and sustainable management of water and sanitation for all" (United Nations General Assembly [UNGA], 2015). As a goal concerning the lifeblood of society and the planet, progress towards the eight SDG 6 targets (Box 1) has catalytic effects across the entire 2030 Agenda.

Safe drinking water and sanitation are human rights. Access to these services, including water and soap for handwashing, is fundamental to human health and well-being. SDG 6, however, goes far beyond water and sanitation services to cover the entire water cycle. Besides domestic purposes, water is needed across all sectors of society, to produce food, energy, goods and services, and to maintain healthy ecosystems that in turn protect life on Earth, all of which form the basis of the SDG 6 targets (Box 1).

Within the SDG monitoring framework, data collection and reporting are based on country data, with national representatives included in the process to ensure that progress is achieved and to strengthen accountability.

Lake Bunyonyi, Kabale, Uganda by Random Institute ©Unsplash

Box 1. SDG 6: Ensure availability and sustainable management of water and sanitation for all

6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all.

6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.

6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.

6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

6.a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.

6.b Support and strengthen the participation of local communities in improving water and sanitation management.

Vijayawada, Andhra Pradesh, India by Sai Kiran Anagani ©Unsplash

1.2. What is the change in water-use efficiency over time and why is it important?

Indicator 6.4.1 is an **economic indicator**, assessing the extent to which a country's economic growth is dependent on the use of water resources. It therefore addresses the impact of economic growth on the use of water resources, with its estimations considering **two different dimensions – hydrological and economic –** based on two sets of data:

- volumes of water used by the different sectors included in the indicator's computation
- gross value added (GVA) of these sectors.

Indicator 6.4.1 was newly introduced by the SDG process in 2015, and had previously not been monitored globally as part of the Millennium Development Goals (MDGs). The introduction of this new indicator presented challenges, such as the need to develop an entirely new methodology to monitor the indicator, and to generate and interpret new data computations due to the indicator's lack of previous data.

The indicator shows the **change in the ratio of the value added to the volume of water use over time**. In this way, water-use efficiency is defined as the value added of a given major sector divided by the volume of water used by that sector, expressed as value/volume (commonly USD/m^3). Comparing the indicator's measurements over time reveals the change in countries' water-use efficiency, providing a complete picture of their situations.

Increasing water-use efficiency over time is strongly linked to the achievement of other SDGs related to the efficient and sustainable use of resources, such as sustainable food production (SDG 2), economic growth (SDG 8), infrastructure and industrialization (SDG 9), cities and human settlements (SDG 11), as well as sustainable consumption and production (SDG 12).

1.2.1. Conceptual framework: setting a common understanding of the hydrological and economic components of indicator 6.4.1

Indicator 6.4.1 estimates the reliance of a country's economic growth on the exploitation of its water resources. When the growth of the indicator is slower than that of the economy, it indicates a potential problem with the medium and long-term sustainability of the economic growth itself, which could be constrained by an increasing shortage of water. In such cases it is essential to integrate information provided by indicator 6.4.2 on water stress.

The volume of water used by each sector was defined based on the definitions set in the System of Environmental-Economic Accounting for Water (SEEA-Water),[1] which defines water use as the water abstracted by a given economic sector or received from another sector. This definition allows for the use of data collected by AQUASTAT under "total water withdrawal (TWW)".

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[1] See https://seea.un.org/content/seea-water.

As this indicator focuses on economy, it is calculated by computing individual indicators for each of the main economic sectors, before aggregating them into a single figure. The indicator is defined as the value added per water used (expressed in USD/m^3) over time of a given major economic sector, revealing the trend in water-use efficiency. Economic sectors are designated following the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4 codes (Box 2).

Box 2. Economic sectors included in the water-use efficiency computation as per the International Standard Industrial Classification of All Economic Activities (ISIC) codes

Water-use efficiency is computed by collecting data about three main economic sectors: agriculture (the production of food, fibres, wood and related products, grouped under agriculture); industrial production (of goods, energy, mining and constructions, grouped under the acronym MIMEC); and services (including households). These sectors are defined more precisely according to the ISIC Revision 4 codes:

1. agriculture; forestry; fishing (ISIC A) (agriculture)
2. mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; constructions (ISIC B, C, D and F) (MIMEC)
3. all the service sectors (ISIC E and ISIC G–T) (services).

Sources: United Nations, Department of Economic and Social Affairs, Statistics Division (2008); Food and Agriculture Organization of the United Nations (FAO) (2019a).

During the methodological development of this indicator, consideration was given to the possibility of using water consumption as a metric for identifying each economic sector's used water volumes. While this would have better aligned the indicator to water productivity (another common agricultural concept), water withdrawal was instead selected, which better aligns the indicator with the SEEA-Water definitions.

However, the concepts of water-use efficiency and water productivity are often used interchangeably, which might create confusion. Box 3 explains how these concepts differ when computing the indicator, while Box 4 provides some definitions that help identify the different variables considered during the indicator's development.

Box 3. Clarifying the concepts of water-use efficiency and water productivity

Water productivity is usually computed as the ratio of the economic or biological output per volume of water consumed in a given production process, mostly in agriculture. Water-use efficiency is computed as the ratio between the volumes of water used by the different sectors and gross value added of these sectors.

The concept of water-use efficiency under indicator 6.4.1 differs from the concept of water productivity because it does not consider the water used in a given activity as an input to production. For example, in this sense, water used for irrigation would not differ from water used to cool down the radiator of a motor car or to flush a toilet in an office space.

Indicator 6.4.1 estimates the reliance of economic growth on the exploitation of water resources, showing the level of decoupling of economic growth from water use, i.e. how much the economy can grow using the same or a lesser volume of water.

Source: FAO (2018).

Box 4. Concepts and variables related to the computation of indicator 6.4.1

- **Water use:** Water that is received by an industry or households from another industry or that is directly abstracted (SEEA-Water (ST/ESA/STAT/SER.F/100), para. 2.21).

- **Water abstraction:** Water that is removed from the environment by the economy (SEEA-Water (ST/ESA/STAT/SER.F/100), para. 2.9).

- **Water use for irrigation (km^3/year):** Annual quantity of water used for irrigation purposes. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater, the direct use of agricultural drainage water, (treated) wastewater and desalinated water (AQUASTAT Glossary).

- **Water use for livestock (watering and cleaning) (km^3/year):** Annual quantity of water used for livestock purposes. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater, the direct use of agricultural drainage water, (treated) wastewater and desalinated water for livestock watering, sanitation, cleaning of stables, etc. If connected to the public water supply network, water used for livestock is included in services water use (AQUASTAT Glossary).

- **Water use for aquaculture (km^3/year):** Annual quantity of water used for aquaculture. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater, the direct use of agricultural drainage water, (treated) wastewater and desalinated water. Aquaculture is the farming of aquatic organisms in inland and coastal areas, involving intervention in the rearing process to enhance production and the individual or corporate ownership of the stock being cultivated (AQUASTAT Glossary).

- **Water use for the MIMEC sector (km³/year):** Annual quantity of water used for the MIMEC sector. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater and the use of desalinated water or direct use of (treated) wastewater. This sector refers to self-supplied industries not connected to the public distribution network (AQUASTAT Glossary; AQUASTAT refers to MIMEC sectors as 'industry').

- **Water use for services sectors (km³/year):** Annual quantity of water used primarily for direct use by the population. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater and the use of desalinated water or direct use of treated wastewater. It is usually computed as the total water used by the public distribution network and can include the part of industries connected to the municipal network (AQUASTAT Glossary; AQUASTAT refers to services sectors as 'municipal').

- **Value added (gross):** Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for the depreciation of fabricated assets or the depletion and degradation of natural resources. The industrial origin of value added is determined by the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4 (World Bank Databank, Metadata Glossary, modified).

Source: FAO (2019a).

Nepal by Dipesh Shrestha ©Unsplash

If water-use efficiency grows **faster** than the value added of an economy, then **efforts to increase water-use efficiency are on the right path**. In this case, the increase in the indicator's results is due to the relative stability or decrease in the volume of water used by the economy as it grows, thus indicating a lower risk of water becoming a limiting factor for economic growth.

If the indicator **follows the same trend as economic growth**, then the **risk of water becoming a limiting factor for economic growth** is linked to the overall amount of a country's available water resources.

If water-use efficiency grows slower than the value added of an economy, then there is a **high risk of water becoming a limiting factor** for economic growth in the medium and long term. This has the potential to jeopardize the overall sustainability of the economic growth itself.

1.3. Economic growth and water use

In addition to providing information on the efficiency of the economic and social use of water resources, indicator 6.4.1 shows the level of **decoupling of economic growth from water use**.

In other words, **indicator 6.4.1 shows how much water use increases if the value added of the economy increases**. It estimates **the extent to which a country's economic growth relies on the exploitation of its water resources**. The indicator's results increase if the value added of a sector or the whole economy grows more than the relevant water use, thus indicating that water is not a limiting factor for economic growth.

1.4. Why decoupling water from economic growth is important

In terms of policy, the indicator aims to identify the point at which increases in water use – if any – become decoupled from the increase in the value added of the economy (i.e. the tipping point). While this may not be something that developing countries experience for some years, anticipating this point should be the focus of water policies to reduce the risk of countries overstretching their available resources, particularly countries with a medium to high level of water stress (see indicator 6.4.2).

The rationale behind this indicator involves providing information on the efficiency of the economic and social use of water resources, i.e. the value added from the use of water in the economy's main sectors, including distribution network losses.

The efficiency of the water distribution systems is implicit within the calculations and could be made explicit if needed and where data are available.

Water-use efficiency is strongly influenced by a country's economic structure, proportion of water-intensive sectors and any 'real' improvements or deteriorations. The indicator can therefore help formulate water policy by focusing attention on sectors or regions with a small water-use efficiency change or with a high water demand but low water-use efficiency. This will guide countries in their efforts to improve water-use efficiency and help them to apply successful actions from sectors or regions with higher water-use efficiency levels to those with lower efficiency levels. Cross-sector planning can be supported by implementing integrated water resources management (IWRM), as measured by indicator 6.5.1 (United Nations Environment Programme [UNEP], 2021).

However, it should be noted that in most cases, devising policies that aim to move water from one economic sector to another to increase the value of water-use efficiency would be ineffective. If a country's general development becomes unbalanced due to its use of water resources, other SDG indicators will signal problems and changes needed, since such unbalancing would likely jeopardize food security and livelihoods in developing countries, particularly those with an agricultural matrix heavily focused on subsistence (which is not visible in this indicator, but would be captured by other related indicators).

Indicator 6.4.1 specifically addresses the target component “substantially increase water-use efficiency across all sectors”, comparing the value added of an economy with the volumes of water used by the same economy, including losses in distribution networks. Increasing water-use efficiency over time means decoupling economic growth from water use across the main water-using sectors, which are agriculture, industry, energy and services.

This is strongly interlinked with sustainable food production (SDG 2), as incomes should increase with improvements in efficiency and value addition to food production; gender equality and natural resources (SDG 5), as reforms to increase water-use efficiency should also complement efforts to secure women's rights and access to markets; economic growth (SDG 8), as resource efficiency should result in economic growth being decoupled from environmental degradation; infrastructure and industrialization (SDG 9), as GVA should increase with sustainable industries; cities and human settlements (SDG 11), as improved accessibility to domestic water supply and ecosystem health should help prevent water-related disasters; and consumption and production (SDG 12), which should become more efficient.

Increasing values in a time series indicate that economic growth is decoupling from water use. It does not necessarily indicate a decline in total water use or a reduction of the impact of water use (though it must be compared with indicator 6.4.2 results to confirm this).

1.5. Setting the scene: lessons learned for the new reporting period and capacity-building initiatives

Indicator 6.4.1 had not previously been monitored worldwide as part of the MDGs and was introduced in the SDG process. As such, an entirely new methodology had to be built to monitor the indicator. Despite not being monitored previously, statistical data were generally available and updated from governmental sources for the variables included in the methodology.

The first phase of the UN-Water Integrated Monitoring Initiative for SDG 6[2] (2015–2018) focused on developing monitoring methodologies and other support tools for the indicators of the aforementioned targets.

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[2] The UN-Water Integrated Monitoring Initiative for SDG 6 brings together the United Nations organizations that are formally mandated to compile country data on the SDG 6 global indicators, and builds on ongoing efforts such as the World Health Organization (WHO)/United Nations Children's Fund (UNICEF) Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP), the Global Environment Monitoring System for Freshwater (GEMS/Water), FAO's global information system on water and agriculture (AQUASTAT) and the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS).

This included pilot testing the monitoring methodologies in five countries: Jordan, the Netherlands, Peru, Senegal and Uganda. After testing the methodology in the five pilot countries, a preliminary global analysis for indicator 6.4.1 was conducted using available databases from international organizations.[3]

The data from these sources were checked with a number of countries to ensure they were representative. This first monitoring process was reported in 2018 (FAO, 2018). From 2019, data have been crosschecked with all countries in two different ways: (1) the custodian agency collects the data and sends them to governments for endorsement; or (2) countries send the data to custodian agencies directly.

After the 2015–2018 phase, two main steps were undertaken with regard to the data-collection process: 1) all Member States received a pre-compiled data-collection worksheet, which had to be revised or updated with new data and returned; and 2) a network of national correspondents who ensure that countries produce regular and consistent data into AQUASTAT was established.

The Integrated Monitoring Initiative for SDG 6,[4] which includes FAO and other United Nations organizations, and is coordinated by UN-Water, aims (at this stage) to help countries increase their technical and institutional capacity for the monitoring of the SDG 6 indicators, along with data collection and reporting. In its endeavour to build national ownership, FAO has developed

Volcano Antisana, Ecuador by Migel Ibanez ©Unsplash

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[3] FAO's AQUASTAT database was used to provide data on water use for agriculture, industry (MIMEC) and services. Economic data on GVA in each of these three major economic sectors were acquired from national statistics departments or other relevant national government agencies and international sources, such as the World Bank, United Nations Statistics Division (UNSD) and Organisation for Economic Co-operation and Development (OECD). These data sources follow the set of concepts, definitions, classifications and accounting rules recommended in the System of National Accounts (SNA), thus enabling country data and economic performances to be compared internationally.

[4] See https://www.sdg6monitoring.org/.

Box 5. Capacity-building resources to support indicator 6.4.1 monitoring by FAO

- SDG indicator 6.4.1 web page: A public website that contains all the background information and updates concerning the monitoring and reporting process.
- SDG indicator 6.4.1 metadata: This document provides definitions and methodological and data-collection considerations.
- Step-by-step monitoring methodology for SDG indicator 6.4.1: This document contains a detailed description of all the information and steps needed to compute the indicator, including an overview of sectoral water use and the guidelines for identifying and processing economic data.
- SDG indicator 6.4.1 e-learning course: The course is available in English, French, Russian and Spanish and provides tools, methods and processes to support countries in monitoring and reporting on the indicator, while also exploring the interlinkages with other SDG targets.
- Regional on-site and online training courses on sustainable water use (SDG target 6.4 indicators): FAO organized four virtual training sessions on SDG target 6.4 for Asia, Latin America and the Caribbean and Africa in 2020 and 2021, and another six regional workshops during 2017–2019 prior to the COVID-19 pandemic.

Notes: For the indicator 6.4.1 web page, see http://www.fao.org/sustainable-development-goals/indicators/641/en/; for the indicator 6.4.1 metadata, see https://unstats.un.org/sdgs/metadata/files/Metadata-06-04-01.pdf; for the monitoring methodology, see http://www.fao.org/3/ca8484en/ca8484en.pdf; for the e-learning course,
see https://elearning.fao.org/course/view.php?id=475 (English)
and https://elearning.fao.org/course/view.php?id=592 (Russian).

In an initial attempt to analyse the results of indicator 6.4.1, FAO drafted a working paper (Rossi and others, 2019), which discussed the changes in water use and water-use efficiency in Europe and in three key developing regions (sub-Saharan Africa, South-Eastern Asia and Latin America and the Caribbean). Furthermore, particular attention was given to the changes in water use, water-use efficiency and related drivers in two groups of countries – major developing economies (G7 countries) and newly industrialized countries (Brazil, China, India, Indonesia, Malaysia, Mexico, South Africa and Turkey). The work carried out for that paper helped to structure the analysis carried out in this report.

2. Method and process: how to monitor and interpret indicator 6.4.1

2.1. Country-led national data-collection and AQUASTAT database aggregation

Data collection for the estimation of both SDG target 6.4 indicators is carried out through AQUASTAT, FAO'S global information system on water and agriculture. AQUASTAT's data-collection method has evolved since 2018 to align with the principles of data gathering that are promoted through the SDGs, i.e. following country-led and country-owned processes.

In this regard, AQUASTAT has established a network of national correspondents across 156 countries (at this moment) to improve country participation and data ownership. Every year, AQUASTAT sends a questionnaire to these national correspondents, which includes the variables needed to calculate indicators 6.4.1 and 6.4.2. Throughout the data-collection process, national correspondents have the key role of ensuring data quality and coordination at the country level. Having national coordination in place will ensure that data are collected in a timely and consistent manner on a regular basis. National ministries and institutions with water-related thematic areas included in their mandate (such as ministries of water resources, agriculture, industry or the environment) usually collect indicator 6.4.1 data.

Countries compile their different variables in the questionnaire (see the reporting template in annex 1), which is returned to FAO for regional and global aggregates to be produced. Sectoral water-use data prior to 2015 were easily obtained from the AQUASTAT database, though such data included long-term estimations that were not entirely suitable for the computation of the water-use efficiency trend.

Once countries submit their data, AQUASTAT carries out a validation process to ensure the quality and consistency of the data, which includes an ongoing dialogue with national correspondents. FAO thoroughly reviews the information reported, using the following tools:

- a manual cross-variable check, which includes a cross-comparison with similar countries and historic data for the countries
- time series coherency, by running an R-script to compare reported data with those corresponding to previous years.

After the validation process, the AQUASTAT database is used to provide data on water use for agriculture, industry (MIMEC) and services. Economic data on GVA in each of these three major economic sectors is acquired from national statistics departments or other relevant national government agencies and international sources, such as the World Bank, United Nations Statistics Division (UNSD) and Organisation for Economic Co-operation and Development (OECD). These data sources follow the set of concepts, definitions, classifications and accounting rules recommended in the System of National Accounts (SNA), thus enabling country data and economic performances to be compared internationally. Economic data are corrected for inflation (see Box 6).

Box 6. How to remove the effect of price changes over time

The effects of price changes over time on time series data can be eliminated by using price indices. The gross domestic product (GDP) deflator (also known as the implicit price deflator) is an important price index that measures the average prices of all goods and services included in the economy.

To convert nominal economic data from several different years into a real value, i.e. inflation-adjusted data, a base year is first chosen and then a price index (GDP deflator in the case of a GDP data series) is used to convert the measurements so that they are measured in terms of the base year's prices.

For the aggregate sectoral value added figures to be used in computing indicator 6.4.1, the suggested base year is 2015, unless defined differently at the country level. All future flows of sectoral value added data can therefore be converted to the base year by using either the GDP deflator series over the period or their respective sectoral deflator series (if sectoral deflators are available).

Source: FAO (2019a).

2.1.1. Spatial and temporal coverage

As this indicator is connected to economic growth, data for its calculation should be collected annually, even in the case where no substantial changes in water use are foreseen on yearly basis.

In any case, particularly in countries with a water stress issue as assessed through indicator 6.4.2, and with strong economic and demographic growth, a reporting period of no more than two years should be considered to be able to build an early trend capable of detecting possible problems.

Inle Lake, Myanmar by Rodolphe Heraud ©Unsplash

2.1.2. Treatment of missing values at the country, regional and global levels

> **At the country level: If scattered data (over time) are available, the linear interpolation method takes place if there are at least two non-missing values in the time series. If not, the only possible way to impute the data is through the carry-forward method. Imputed data are displayed with an appropriate qualifier in AQUASTAT.**

> **At the regional and global levels: If country data are missing, the indicator value will be considered in the average of countries in the same region. Imputed data are displayed with an appropriate qualifier in AQUASTAT.**

2.1.3. Regional aggregations

The aggregation for global and regional estimations is carried out by summing up the values of the formula's various variables, i.e. value added by sector and water use by sector. The aggregated indicator is then calculated by applying the formula with those aggregated data, as if it were a single country.

2.2. Calculation methodology

Indicator 6.4.1 has been defined as the change in water-use efficiency over time (CWUE), which is formulated as the GVA per unit of water used (expressed in USD/m^3) of a given major economic sector (showing the trend in water-use efficiency). The GVA[5] (defined in Box 4) is calculated by adding all outputs and subtracting intermediate inputs, without making deductions for the depreciation of fabricated assets or the depletion and degradation of natural resources. Indicator 6.4.1 is calculated as the sum of the agriculture, industrial and services sectors (Box 2), weighted according to the proportion of water used by each sector over the total uses, using the formula:

$$WUE = A_{we} \times P_A + M_{we} \times P_M + S_{we} \times P_S$$

Where:

- WUE = water-use efficiency [USD/m^3]
- A_{we} = irrigated agriculture water-use efficiency [USD/m^3]
- M_{we} = MIMEC water-use efficiency [USD/m^3]
- S_{we} = services water-use efficiency [USD/m^3]
- P_A = proportion of water used by the agriculture sector over the total use
- P_M = proportion of water used by the MIMEC sector over the total use
- P_S = proportion of water used by the services sector over the total use

It is important to note that only surface water and groundwater (so-called blue water) should be considered when computing the indicator. This is particularly important regarding water use for the agriculture sector. For this reason, a specific parameter (C_r) has been introduced in the formula to extract the amount of agricultural production carried out in rainfed conditions. For the same

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[5] Computing the indicator in an aggregated manner (i.e. total GDP over total water use) would lead to an overestimation of the indicator. This is because the only value produced under irrigation for the agriculture sector must be counted when calculating the indicator, meaning the sum of the value added of the various sectors used in these formulas is not equivalent to the country's total GDP.

reason, the value added of subsectoral productions that mainly use non-abstracted water should not be included when calculating the overall sectoral value added. The computing of each sector is as follows:

A_{we} Irrigated agriculture water-use efficiency (USD/m^3). This is calculated as the agriculture value added per agriculture water use and is used as a proxy indicator for the agriculture sector's water-use efficiency. It is determined using the formula:

$$A_{we} = \frac{GVA_{al} + GVA_{aa} + [GVA_{ai} \times (1 - C_r)]}{V_a}$$

Where:

- GVA_{al} = gross value added of the livestock subsector [USD]

- GVA_{aa} = gross value added of the freshwater aquaculture subsector [USD]

- GVA_{ai} = gross value added of the irrigated cultivations subsector [USD].

Forestry and fishing values should not be included in the calculation, with the exception of forest tree nurseries and freshwater aquaculture. In ISIC codes, the sectors to consider are:

> 01 Crop and animal production, hunting and related service activities

> 0210 Silviculture and other forestry activities

> 0322 Freshwater aquaculture.

The numerator of the formula therefore corresponds to the GVA of agriculture subsectors, excluding rainfed systems, and is abbreviated as $GVA_{a\text{-}rev}$ in this report.

- V_a = volume of water used by the agricultural sector [m^3] This is the annual quantity of self-supplied water used for irrigation, livestock (watering, sanitation, cleaning, etc.) and aquaculture purposes. It corresponds to ISIC sectors A [1–3], excluding forestry and fishing. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater, direct use of agricultural drainage water, (treated) wastewater and desalinated water.

- C_r = proportion of agricultural GVA from rainfed agriculture.

If disaggregated data on value added of rainfed and irrigated agriculture are not reported in national accounts, it can be calculated from the proportion of irrigated land on the total cultivated land, using the formula:

$$C_r = \frac{1}{1 + \frac{A_i}{(1 - A_i) * 0.562}}$$

Where:

- A_i = proportion of irrigated land on the total cultivated land, in decimals

- 0.562 = the generic default ratio between rainfed and irrigated yields (Yri).

Box 7. FAO's estimations of the ratio between rainfed and irrigated yields

For the purpose of the indicator 6.4.1 calculation on water-use efficiency, this yield ratio enables a more accurate estimation of agricultural production, and thus gross value added (GVA), by referring to water use in irrigated agriculture. The yield ratio is equal to the yield of a rainfed crop over the yield of the same irrigated crop, using the formula:

$$Yri = \frac{Yr}{Yi}$$

Where:

Yri = ratio between rainfed and irrigated yields

Yr = mean yield in rainfed conditions

Yi = mean yield in irrigated conditions.

In countries where there is no rainfed production, *Yri* is null because *Yr* is also null. The practical implication on the agricultural GVA is that no rainfed agriculture portion is discounted, and the whole agricultural GVA is included for the sectoral water-use efficiency of agriculture.

The initial definition of indicator 6.4.1 presented in the previous report took into consideration a very coarse approximation of the ratio between rainfed and irrigated yields. This approximation was based on the idea that 20 percent of the world's crop areas were irrigated but produced 40 percent of the global crop production, and that rainfed areas represented 80 percent of the surface area but yielded only 60 percent of total production (FAO, 2007), resulting in a ratio of 0.375. However, this estimation did not reflect the diversity of the irrigation situation across countries, such as the widely differing benefits of irrigation between humid and arid areas. More accurate and country-specific estimations were therefore needed to provide a better parameter for disaggregating rainfed and irrigated agricultural GVA.

Using the same 2006 baseline data as the 2012 FAO study Agriculture towards 2030–2050, the difference between rainfed and irrigated situations was calculated for each crop with available data from each country. This means that the yield ratio cannot be calculated when:

- a crop is not cultivated in both conditions, i.e. irrigation and rainfed within the country
- at least one of four needed data (area and production under rainfed conditions and area and production under irrigated conditions) is not available.

In general, countries could calculate a yield ratio for 5–10 crops. Once the yield ratio was calculated for all possible crops within a country, an average value was calculated at the national level, weighted on the area of each crop (to give more importance to the main crops).

This method has been used to calculate yield ratios for 95 countries. For the remaining countries, a new default value was estimated as an average of the 95 national yield ratios, and equal to 0.562.

$$\frac{\sum_{n=1}^{95} Yri_n}{95} = 0.562$$

The yield ratio is considered a stable variable for the C_r calculation. However, when more accurate data become available, it could be updated regularly to reflect the change in ratio yields.

Source: FAO (forthcoming).

M_{we} MIMEC water-use efficiency (USD/m^3).
This is the value added per unit of water used by mining and quarrying, manufacturing, electricity, gas, steam, air conditioning supply, and constructions, using the formula:

Where:

$$M_{we} = \frac{GVA_m}{V_m}$$

- GVA_m = gross value added by MIMEC (including energy) [USD] This is computed by adding the value added of each of the four MIMEC divisions as defined in ISIC codes B, C, D and F.

- V_m = volume of water used by MIMEC (including energy) [m^3] This is the annual quantity of water withdrawn for industrial uses. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal of fossil groundwater and the potential use of desalinated water or direct use of (treated) wastewater. This sector refers to self-supplied industries that are not connected to the public distribution network. It includes cooling for thermoelectric plants, but excludes hydropower. However, water use for this sector should include evaporation losses from artificial lakes that are used for hydropower production. This sector corresponds to ISIC sectors B, C, D and F.

S_{we}. Services water-use efficiency (USD/m^3).
This is the services sector value added divided by the water supplied by the water collection, treatment and supply sector. It is calculated using the formula:

$$S_{we} = \frac{GVA_s}{V_s}$$

Where:

- GVA_s = gross value added of services from ISIC sectors E and G–T [USD]

- V_s = volume of water used by the services sector [m^3].
  This is the annual quantity of water withdrawn primarily for direct use by the population. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal of fossil groundwater and the potential use of desalinated water or direct use of treated wastewater. It is usually computed as the total water withdrawn by the public distribution network and can

include the part of industries connected to the municipal network. It corresponds to ISIC sector E.

$\mathbf{P_A}$, $\mathbf{P_M}$ and $\mathbf{P_S}$ are calculated by dividing the volumes of water used by each sector ($\mathbf{V}_a$, $\mathbf{V}_m$ and $\mathbf{V}_s$) by the total water use.

Finally, the change in water-use efficiency (CWUE) is computed as the ratio of water-use efficiency in time (WUE_t) minus water-use efficiency in time t-1 (WUE_{t-1}), divided by WUE_{t-1} and multiplied by 100:

$$CWUE = \frac{WUE_t - WUE_{t-1}}{WUE_{t-1}} \times 100$$

To calculate the trend over a longer period of time, the following formula can be used:

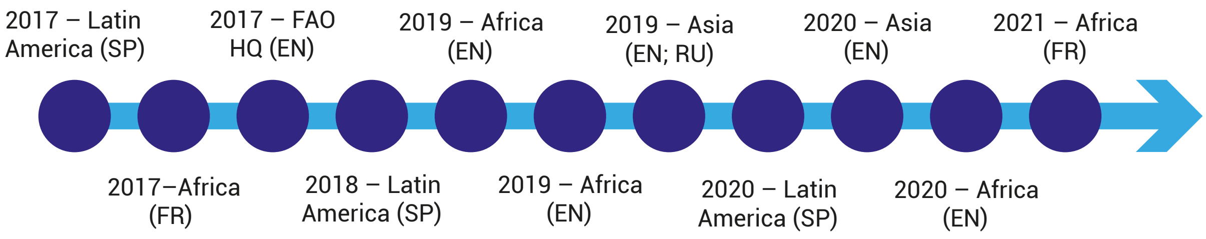
$$TWUE = \frac{WUE_t - WUE_{t_0}}{WUE_{t_0}} * 100$$

2.3. Case study: how are countries facing complex data collection?

The monitoring methodology of the SDG indicators can be challenging, especially for target 6.4. FAO has therefore organized several regional workshops in different languages, to take place both on-site and online, to improve the capacity of the national monitoring teams.

The target audience were people involved in water-use monitoring and management and environmental statistics in the countries that participated in each of the regional workshops.

One of the workshops' main outcomes was to jointly identify constraints, needs and opportunities about the data-collection process. A strengths, weaknesses, opportunities and threats (SWOT) analysis was therefore carried out by the participants and guided by FAO facilitators, which revealed the following:



MAIN STRENGTHS	MAIN WEAKNESSES
• Existing suitable institutional framework and professional capacity. • 2030 Agenda incorporated into national frameworks/existing legal frameworks. • Data availability (some aspects of water data). • Financial resources.	• Coordination lacking among institutions and/or no national data-collection policy for the indicators, and decentralized water management with different stages of implementation. • Some variables not collected (systematically and countrywide). • Missing or partially digitalized data collection and sharing mechanisms and practices.
MAIN OPPORTUNITIES	**MAIN THREATS**
• SDG monitoring support from outside/ exchanges with other countries. • Technological progress (water-use efficiency measuring stations to generate data).	• Lack of general awareness (in society, industry, the agricultural sector regarding the use of water) and political will or prioritization of the thematic area. • Limited resources.

The purpose of this analysis is to help define the data-collection process in a way that ensures weaknesses and threats do not become constraints to countries' strengths and opportunities.

Following discussions with country representatives about national data-collection processes, it can be concluded that there are three main aspects that will need further attention and support:

- the lack of knowledge on how to collect data
- the distribution of data among different institutions, which can make it somewhat challenging to collate the data at the right scale
- the fact that data may already be collected for variables, but may not be suitable for the questionnaire.

3. Results and analysis

3.1. Challenges: dealing with data gaps in the computation of indicator 6.4.1

A lack of accurate, complete and up-to-date data remains one of the main constraints to monitoring indicator 6.4.1 and assessing water-use efficiency. **Without specific efforts by countries, there may be no data updates, meaning no monitoring would be possible**. **The data-collection and analysis process still present significant challenges**, since not all countries report on all the variables needed to calculate the indicator, while some do not report annually as required for insightful and accurate monitoring.

In 2020, AQUASTAT dispatched the questionnaires to national correspondents in 156 countries. Overall, 71 questionnaires were returned, indicating a response rate of 46 percent, which is similar to that of previous years. The indicator values for the rest of the countries were calculated based on vertical imputations using the carry-forward method.

Questionnaires can be completed retrospectively, meaning that countries have a three-year period to report on previous years (for example, the 2020 questionnaire contained data for the years 2016, 2017 and 2018. Analysis of the regional response rate indicates that Europe is most active in providing data and that Africa and Southern Asia need further capacity-building and support in the near future (Figure 1).

This unbalanced response across regions can affect the results of the water-use efficiency computation. In fact, the results obtained with the current data series may have some bias:

> **Not all countries report on a yearly basis, and some report for periods longer than five years. While this can be resolved by using the carry-forward method to estimate missing values, the accuracy of the data is uncertain. In addition, missing data for certain country variables will result in lower values for these variables when aggregated at the regional or global levels.**

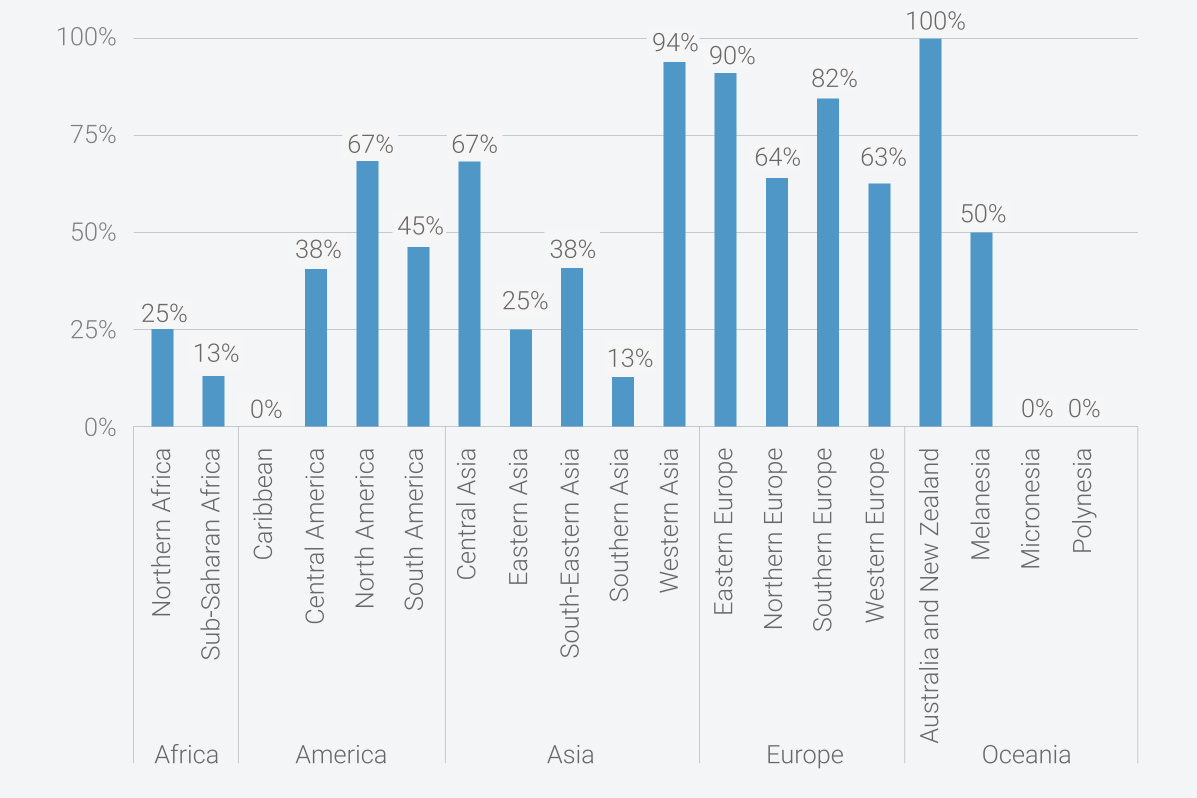
> **The countries that report have more influence on the total values than the countries that do not report. Their aggregate value may therefore often reflect a higher increase or decrease in the volume of water used by sectors than the aggregate value of countries that report less frequently. Furthermore, scattered values or values from just one year mean that changes cannot be detected over time (see Table 1 for an example of how results can change based on sampled countries).**

For this specific report, data from 166 countries were available for a period from 2006 to 2018, though data prior to 2015 included too many long-term estimations of some variables in the time series.

As explained previously, two sets of data are needed to compute the indicator: 1) economic data, updated yearly by agencies such as UNSD and collected by AQUASTAT; and 2) water-use data, which are shared by countries and collected through AQUASTAT questionnaires.

Water-use data were not collected yearly before 2017, meaning few countries reported such data yearly before this date, nor as frequently as required to build a time series trend[6].

Figure 1. Percentage of questionnaires received by subregion in 2020



Source: FAO

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[6] Countries that have their water-use data for all or two sectors imputed for more than three years between 2006 and 2018 were eliminated.

Table 1. Water-use efficiency results after aggregating values of two different country samples

2018	WUE (USD/m^3)	Time frame of data set
86 countries	27.3	2006–2018
166 countries	18.9	2015–2018

Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

Only 86 countries regularly reported water-use data since 2006, and were therefore the only data used to obtain a reliable longer-term perspective of the dependency of economic growth on water usage. However, these 86 reporting countries only represent around 56 percent of the 2018 world population, whereas the longer list of 166 countries covers more than 99 percent of the world population.

To overcome this shortcoming, the approach chosen for this report was to provide an initial conclusion of the water-use efficiency change of the 166 countries from 2015–2018 and then to carry out a more detailed analysis of the potential decoupling of economic growth and water use for the 86 countries with available data from 2006 to 2018. Despite the uncertainty and bias that such calculations may include, there is an overall increase in the water-use efficiency of both time series, as shown in the following sections.

3.2. How is the change in water-use efficiency over time evolving globally and by sector?

As explained previously, 166 countries have data available from 2015 to compute the indicator, which can provide an overall picture of the change in water-use efficiency globally from 2015 to 2018 (the most recent validated data available). **Water-use efficiency rose from 17.3 USD/m^3 in 2015 to 18.9 USD/m^3 in 2018 worldwide** (Figure 2),[7] representing a 10 percent increase in efficiency. However, global values hide regional differences. The proportion of countries generating water-use efficiency results over the global value of each year varied from 45 percent in 2015 to 46 percent in 2018. Figure 2 shows how regions also have different ranges of efficiency, as the economies of underdeveloped, developing and developed countries have distinct volumes that should not be compared in gross terms, but in their capacity to improve water-use efficiency, i.e. with a positive value in water-use efficiency change (Figure 3).

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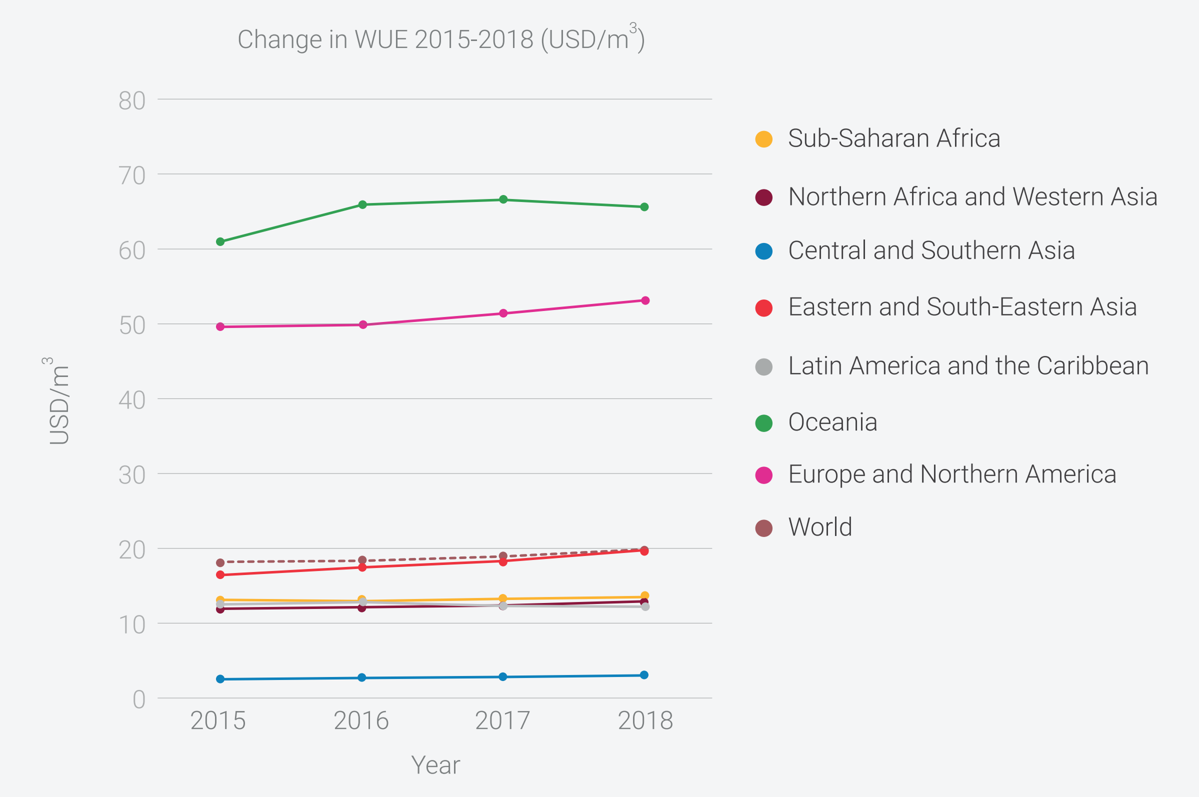
[7] In the previous progress report (2018), the baseline water-use efficiency value was reported at 15 USD/m^3, which is lower than the present value of 17.3 USD/m^3. This is due to the revision of the data-collection process, which now includes imputation rules as described in this report.

Figure 2. Change in water-use efficiency during 2015–2018 for 166 countries

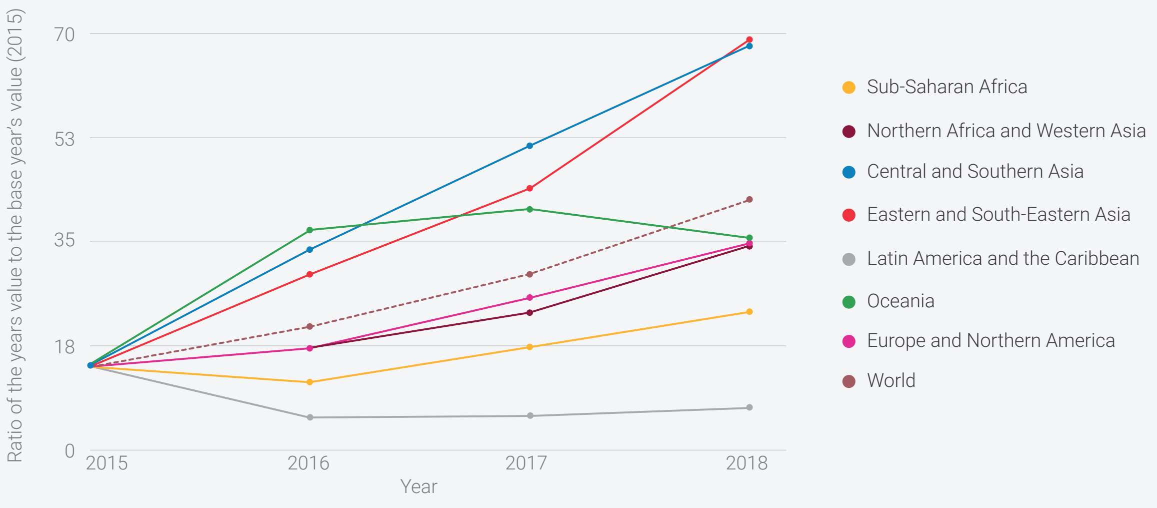


Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

In relative growth terms, some regions are moving faster than others in increasing water-use efficiency (Figure 3). Central and Southern Asia show the highest growth rates from 2015 to 2018, while Latin America and the Caribbean shows a slow increase, with Oceania showing a slight decrease.

By Anders Jilden ©Unsplash

Figure 3. Trend in water-use efficiency in the different regions and globally during 2015–2018 for 166 countries

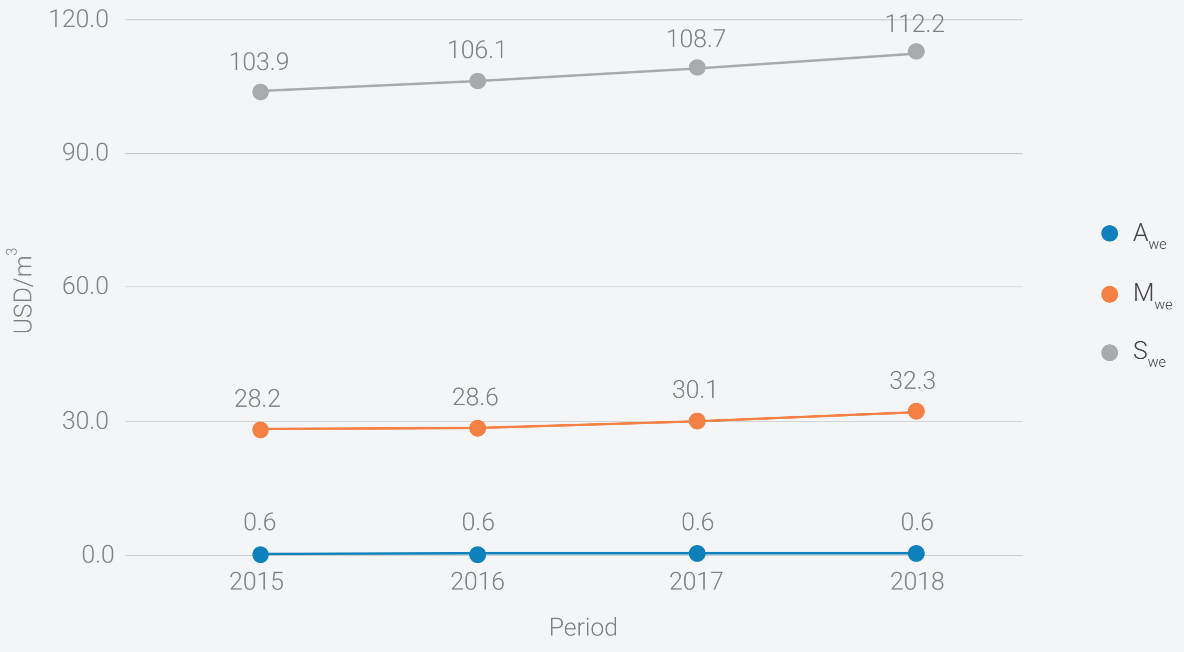


Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

At the global scale, all economic sectors have seen an increase in their water-use efficiency since 2015 (Figure 4). In 2018, the industrial sector had a water-use efficiency equivalent to 32.3 USD/m^3, the services sector 112.2 USD/m^3 and the agriculture sector 0.6 USD/m^3. Compared with 2015, this represents an increase of 15 percent in the industrial sector and 8 percent in both the services and agriculture sectors.

Near Taleqan Dam, Taleqan, Alborz Province, Iran by Saeed Sarshar ©Unsplash

Figure 4. Water-use efficiency changes from 2015 to 2018 in major economic sectors and globally for 166 countries



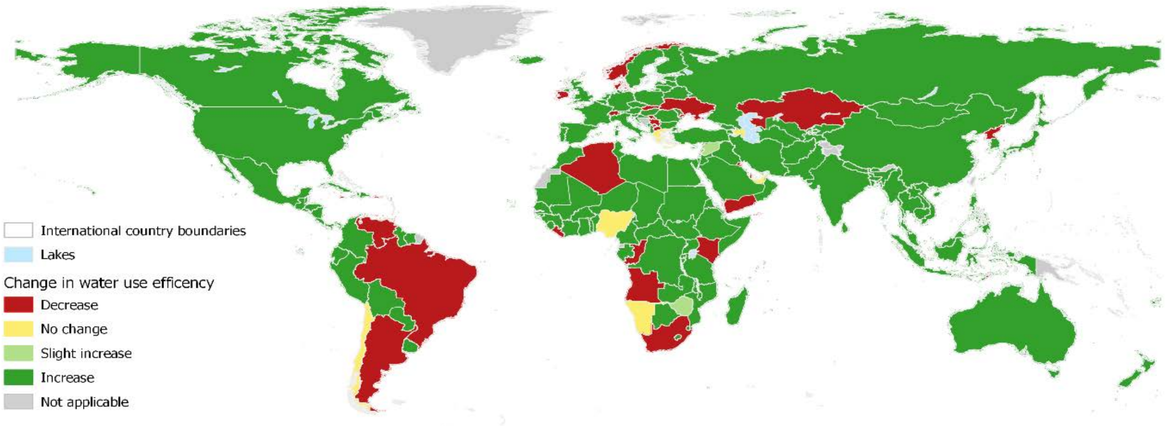
Note: A = agriculture; M = industry; S = services.

Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

As explained previously, two types of data are needed to compute indicator 6.4.1: data on the water used by each of the major sectors; and data on the GVA of these sectors. To understand what the change in water-use efficiency means, it is necessary to analyse how the water use and economic output of each sector is evolving.

Figure 5 shows how the water-use efficiency of the 166 countries changed between 2015 and 2018. Most countries increased their water-use efficiency during this period, with 26 countries experiencing a decrease.

Figure 5. Change in water-use efficiency between 2015 and 2018



Notes: Water-use efficiency changes: increase = by more than 1 percent; slight increase = by 0.5–1 percent; decrease = by more than 1 percent; no change = increase/decrease by less than 0.5 percent.

Source: FAO IMI-SDG6 elaboration based on FAO. 2021. The source of the international country boundaries is UNmap. 2018.

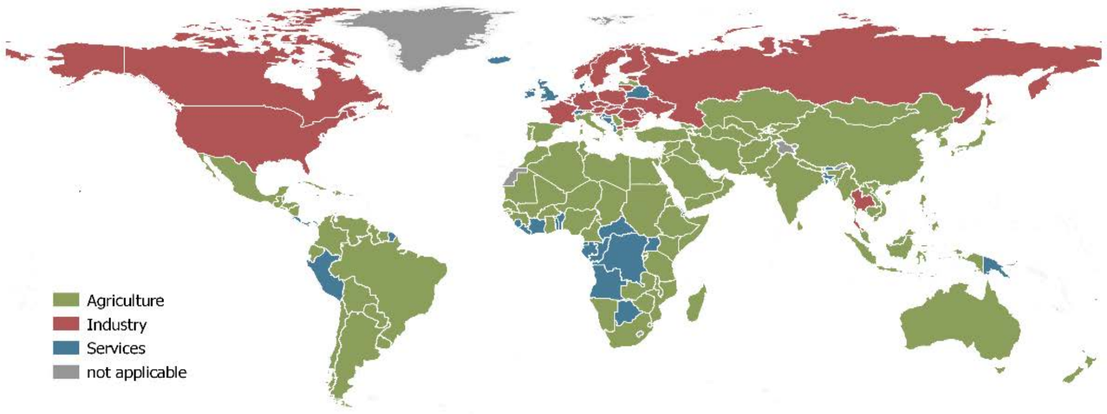
3.2.1. Water data

As Figure 6 shows, there were some changes in water withdrawals made by the main sectors between 2006 and 2018. For example, the industrial sector in developed countries such as Switzerland increased its water demand (where previously the services sector had the largest water demand), with services becoming the most water-demanding sector in Latvia and Lithuania (shifting from agriculture, which previously had the largest demand).

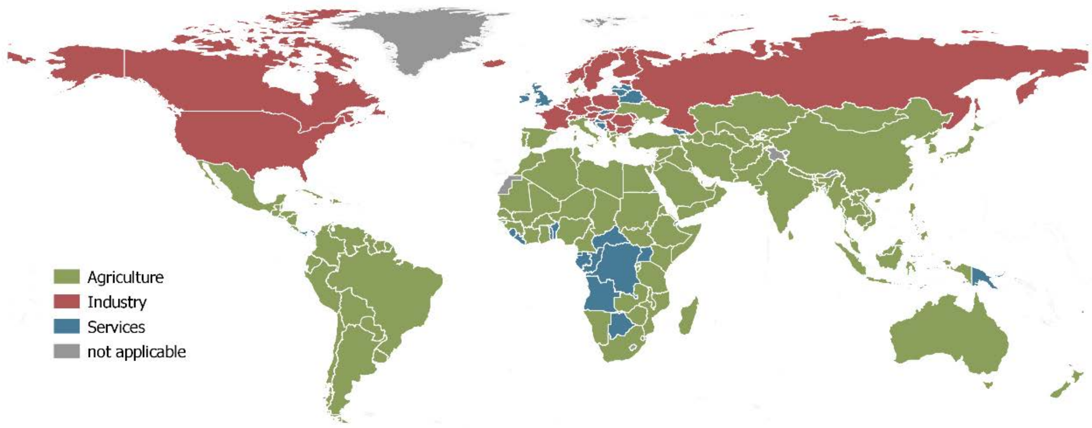
Nevertheless, agriculture continues to have the largest demand in most countries, with notable exceptions in developed countries of the northern hemisphere and sub-Saharan developing countries, where most water withdrawals come from the services sector, but show low safely managed coverage levels of water supply (World Health Organization [WHO]/United Nations Children's Programme [UNICEF] Joint Monitoring Programme [JMP], n.d.).

Figure 6. Dominant sectors for freshwater withdrawals in 2006 and in 2018

Dominant sector for freshwater withdrawal, by country (year 2006)



Dominant sector for freshwater withdrawal, by country (year 2018)

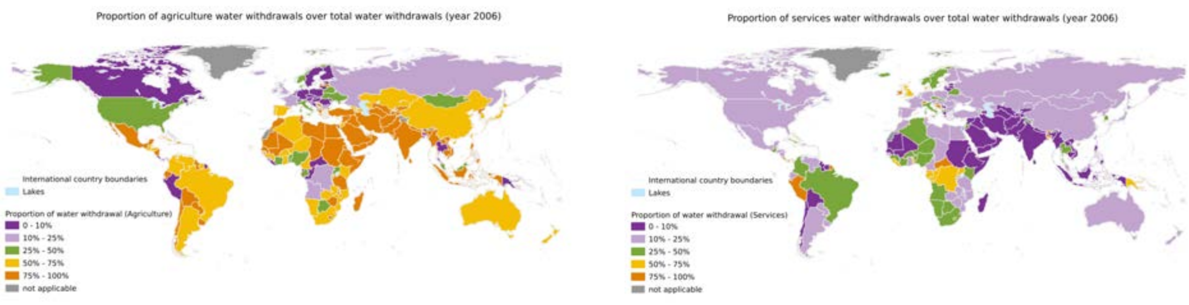


Note: There were no data available on agriculture for Thailand, and no data on agriculture and industry for Peru in the 2006 time series.

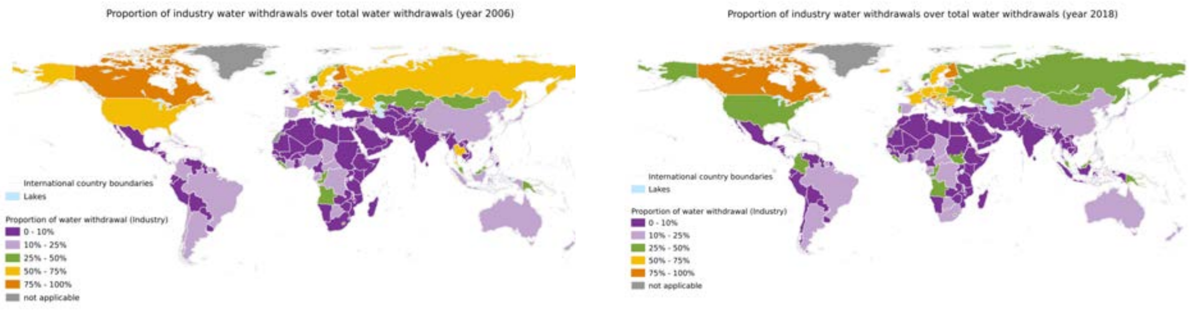
Source: FAO IMI-SDG6 elaboration based on FAO. 2021. The source of the international country boundaries is UNmap. 2018.

Figure 7 shows how in some cases, the proportion of water withdrawals varied between the three sectors during 2006–2018. For example, some Central European, sub-Saharan African and Central Asian countries increased their agricultural water withdrawals, which was reflected in the reduction of the proportion of water used by the other sectors. Due to the increasing urban population growth trend, services water withdrawals are expected to increase in the short term.

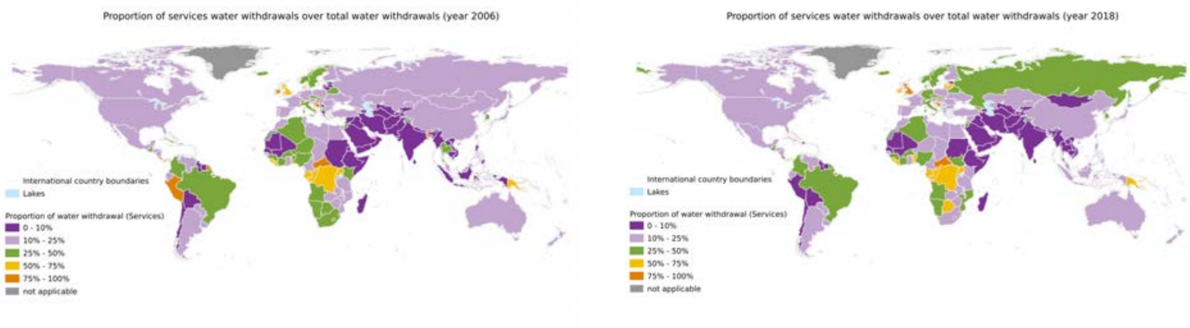
Figure 7. Proportion of withdrawals in each of the sectors in 2006 (left) and 2018 (right)



a) Proportion of agricultural withdrawals over total water withdrawals



b) Proportion of industrial water withdrawals over total water withdrawals



c) Proportion of services water withdrawals over total water withdrawals

Note: There were no data available on agriculture for Thailand, and no data available on agriculture and industry for Peru for the 2006 time series.

Source: FAO IMI-SDG6 elaboration based on FAO. 2021. The source of the international country boundaries is UNmap. 2018.

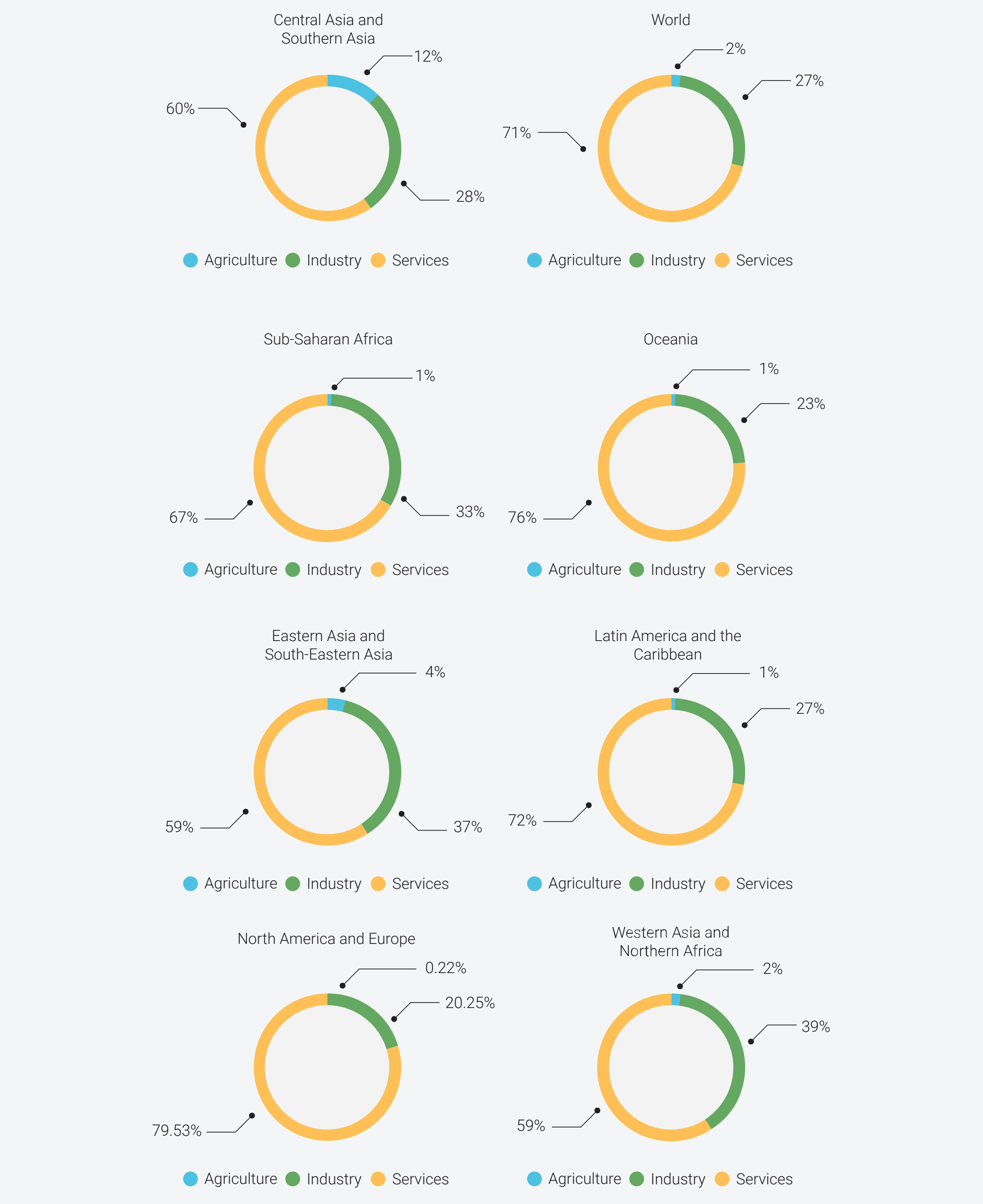
3.2.2. Economic data

The selected variable to compute economic data on this indicator is GVA. As described previously, different ISIC categories were selected for each economic sector, with the values then compiled (see sections 1.2 and 2 and FAO (2019a) for an overall view of the GVA calculation under indicator 6.4.1). Unlike water-use data, these figures are available each year.

The GVA of each sector varies according to the country's economic structure. However, activities related to the industrial and services sectors generate more added value than agricultural activities, both irrigated and rainfed. Globally, water-related activities included in the services sector generate 71 percent of total water-related GVA, industry-related activities 27 percent and irrigated agriculture 2 percent. Figure 8 shows the proportion of each sector in the generation of GVA for the different SDG regions. While there may be regional differences, irrigated agriculture contributes less to economies' GVA overall, and is more important in Central and Southern Asian countries (12 percent).

Antisana, Ecuador by Mauricio Munoz ©Unsplash

Figure 8. Global and regional gross value added for water-related activities included in the three main economic sectors in 2018



Notes: Agriculture = $GVA_{a\text{-}rev}$ for agriculture without the rainfed subsector; Industry = GVA_m of MIMEC; Services = GVA_s of services. Results are from the 166 selected countries.

Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

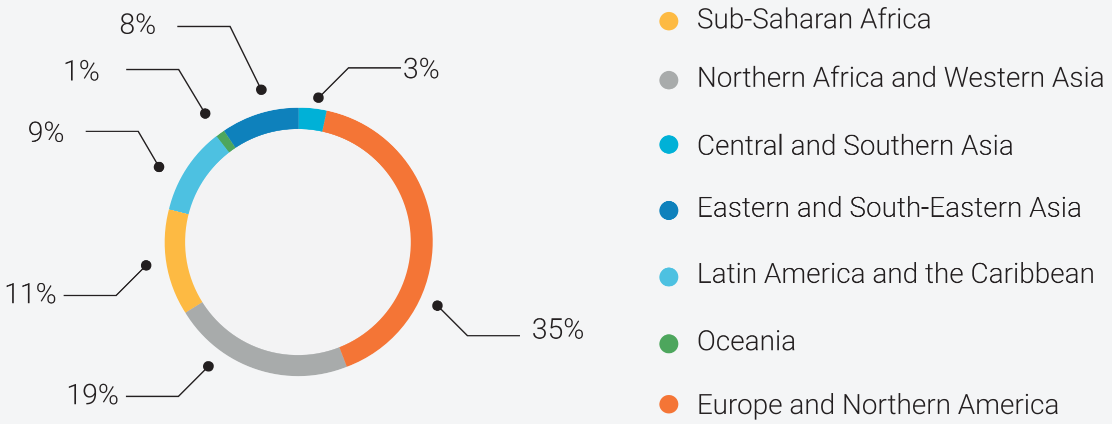
Analysing the water withdrawal and GVA results from the global cohort of 166 countries shows that agriculture consumes more water and generates less value added than the other sectors. A balance between food security, sustainable water use, and economic growth must therefore be sought.

3.3. Are economies decoupling economic growth from water use?

Complete data sets are needed to answer this question. Understanding the change in economic dynamics in relation to water use is only possible through robust data in a long time series, yet global data has only been available since 2015.

This section analyses the water-use efficiency trend in the selected 86 countries from 2006 before analysing the potential decoupling or dependency that economies have in relation to water. These 86 selected countries are distributed geographically, as shown in Figure 9.

Figure 9. Geographical distribution of the 86 countries with available long time series data



3.3.1. Change in water-use efficiency results from the selected countries

The three major sectors have increased their water-use efficiency over time (Figure 10). Water-use efficiency in agriculture increased from 0.5 USD/m^3 to 0.8 USD/m^3, industry from 18.5 USD/m^3 to 31 USD/m^3, and services from 104 USD/m^3 to 135.9 USD/m^3 (Table 2). This means that the industrial sector has experienced the largest net efficiency gains from 2006 to 2018. An analysis of the countries shows that the largest water-use efficiency gains took place in countries with highly developed industrial and services sectors.

This reflects the important reduction in water withdrawals in the industrial sector of these countries, at least partially due to the establishment of water quality regulations that made it cheaper for industry to recycle cooling water rather than discharge it into the environment.

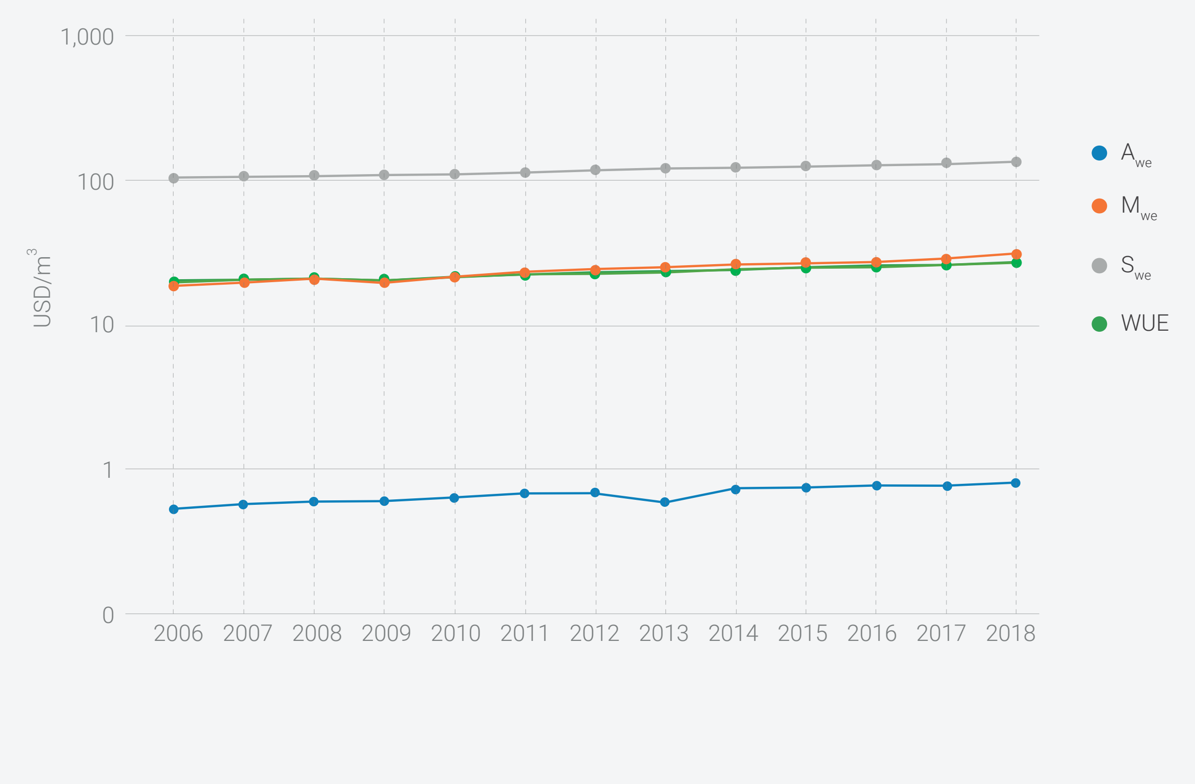
The overall reduction in industrial sector withdrawals in the selected countries is likely due to their type of economy. For example, industry may have a greater weight on the overall GVA of these countries' economies, or they may have a more developed services sector than countries not included in the 86 selected countries. A comparison of the results from Figure 10 with the results of Figures 2 and 4 shows how the 86 countries deviate from the 166 countries previously analysed, resulting in a water-use efficiency value of 27.3 USD/m^3 in 2018 and 18.9 USD/m^3, respectively.

Table 2. Water-use efficiency change, total and per sector, from 2006 to 2018, in the 86 selected countries

	2006 (USD/m^3)	2018 (USD/m^3)	Percentage change of WUE
A_{we}	0.5	0.8	51
M_{we}	18.5	31.0	67
S_{we}	104.0	135.9	31
WUE	20.0	27.3	36

Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

Figure 10. Water-use efficiency values from 2006 to 2018 for the total withdrawals and sectoral withdrawals in the 86 selected countries



Notes: A = agriculture; M = industry; S = services. Shown with a logarithmic scale.

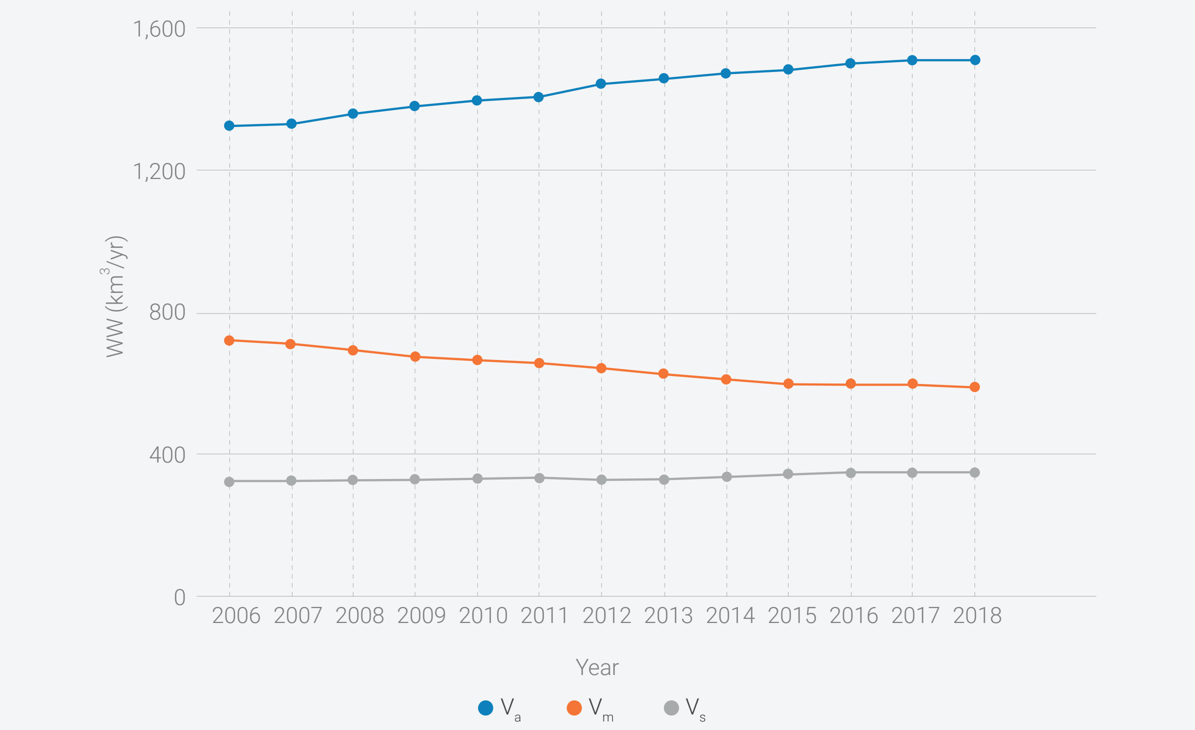
Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

3.3.2. Decoupling or dependency of economy and water use in the 86 countries

Given the water-use efficiency results, it is important to determine whether they can be interpreted as a decoupling of economic growth from water use (i.e. no more water input is needed to generate added value), or a dependency (i.e. new added value is dependent on water use).

Figures 11 and 12 present the water use and economic data changes that have occurred over the years. Considering the selection of countries as an aggregated unit, agricultural water withdrawals show a constant rate of increase over the years, and a total increase of around 14 percent, industrial withdrawals show a decrease of around 18 percent, and services withdrawals show an increase of around 9 percent. An analysis of the GVA changes over the years shows that the services sector's GVA has had a more pronounced increase than the other sectors, though irrigated agriculture has had steady growth (Figure 12). Industrial GVA is increasing, yet industrial water use is decreasing.

Figure 11. Water withdrawals by sector in the 86 selected countries from 2006 to 2018



Notes: V_a = agricultural withdrawals; V_m = industrial withdrawals; V_s = services withdrawals.

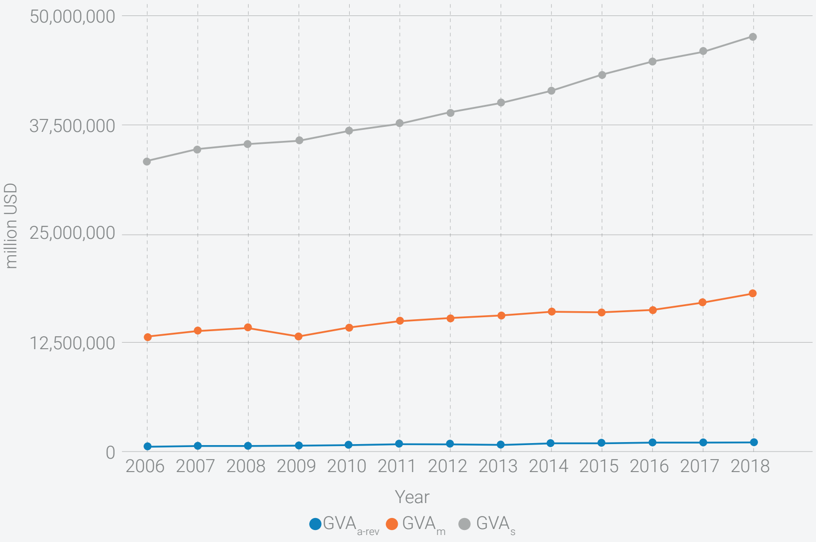
Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

These two last factors are already an indication of the potential decoupling of economic growth and water use in these sectors and countries. As previously stated, the 86 selected countries likely include mostly developed and fast developing economies from the regions, and lack developing or underdeveloped countries, especially from Africa and Southern Asia.

Figure 13 presents the GVA changes of each economic sector used to compute indicator 6.4.1, in relation to total water withdrawals for the 86 selected countries. Based on the data, it can be determined that there was a dependency between the GVA and total water withdrawals (more water was required to generate a marginal value added) until 2016. However, since then, the trend has seemingly changed, indicating a potential decoupling of economic growth and water use. It should be noted though that these results are preliminary, and it is therefore too early for a solid conclusion to be made. The fact that there are only three data points, which show a new trend, are not conclusive.

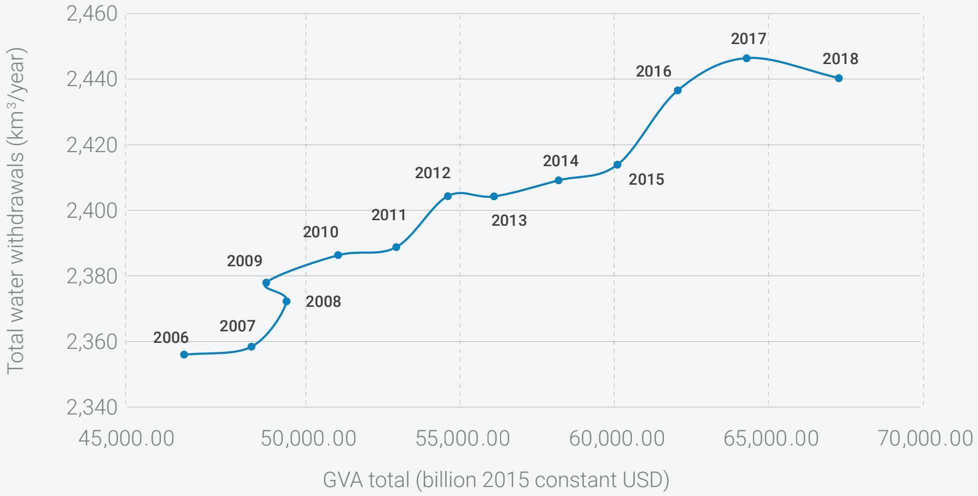
Analysing the changes in water used to generate added value within each sector (Figures 14a, 14b and 14c) reveals strong differences in line with the observations made from Figures 11 and 12.

Figure 12. Gross value added for the three main sectors (irrigated agriculture, industry and services) in the 86 selected countries from 2006 to 2018



Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

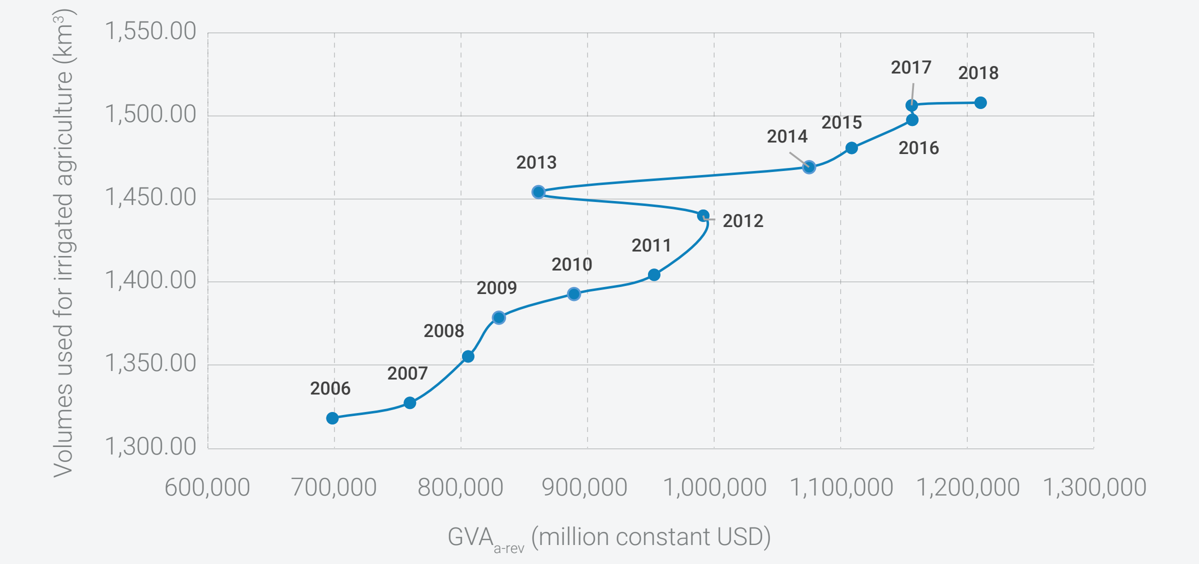
Figure 13. Volume of water used to generate gross value added in three major sectors of the 86 selected countries



Note: In the last years of the time series a potential overall decoupling of water use and value added can be observed. Future data collection and analysis will verify the real trend.

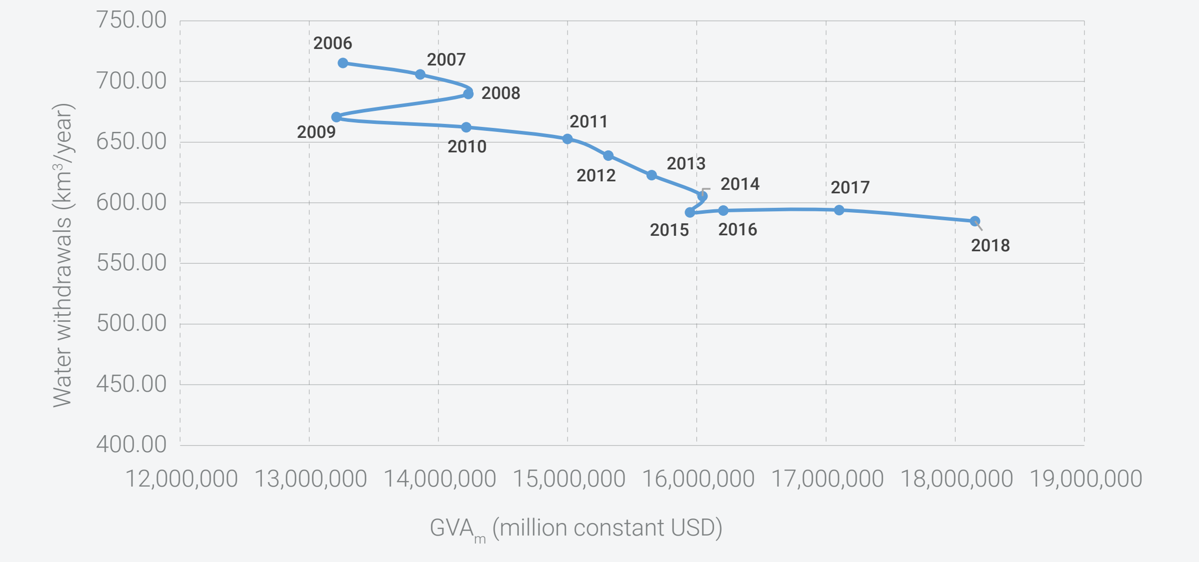
Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

Figure 14a. Volume of water used to generate gross value added in the agricultural sector of the 86 selected countries from 2006 to 2018



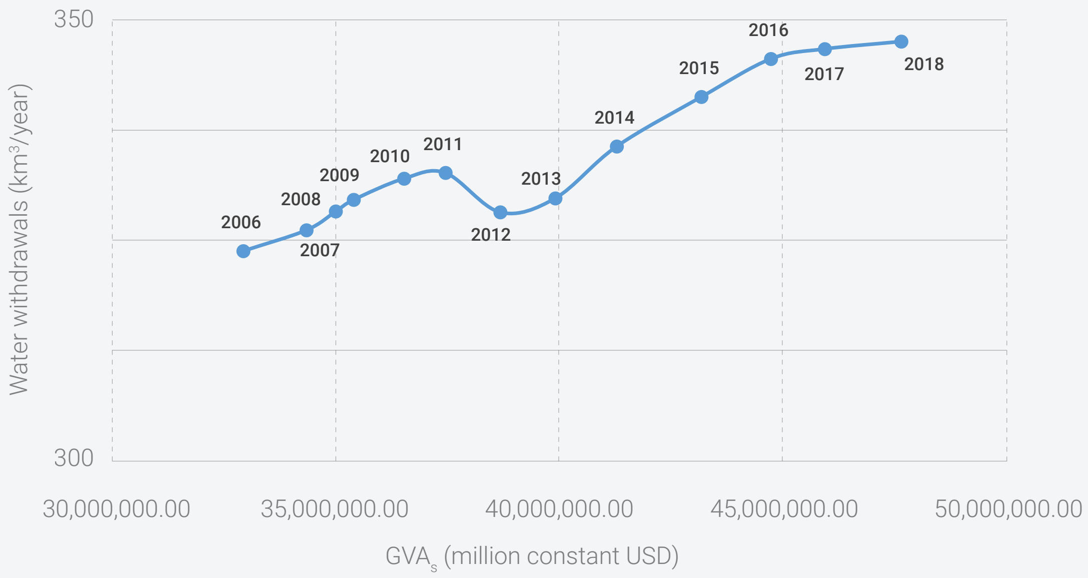
Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

Figure 14b. Volume of water used to generate gross value added in the industrial sector of the 86 selected countries from 2006 to 2018



Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

Figure 14c. Volume of water used to generate gross value added in the service sector of the 86 selected countries from 2006 to 2018



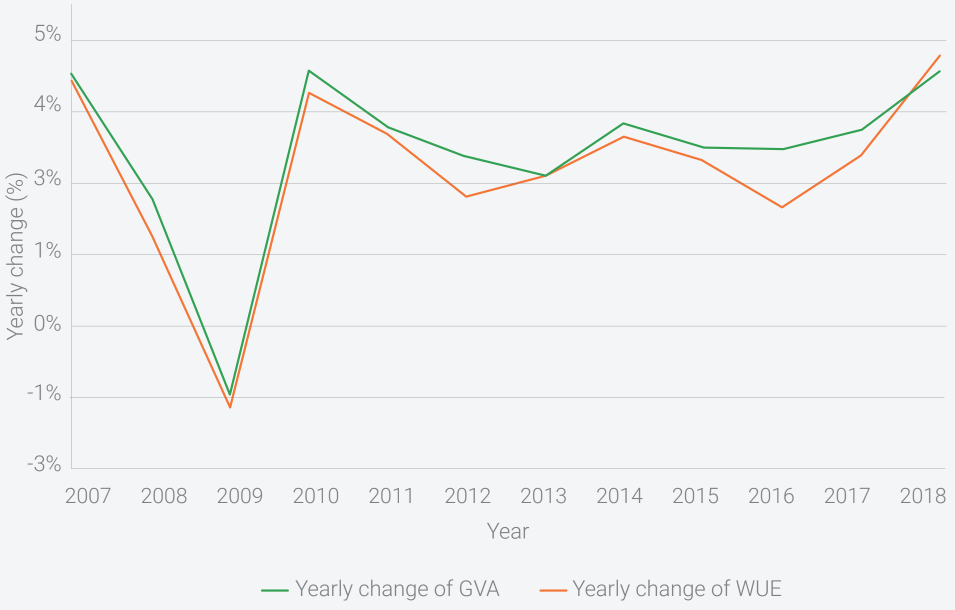
Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

The water use and GVA dependency trend seems to be continuing for the agriculture and services sectors, though in the services sector, GVA is growing much faster than the use of water.

Within the industrial sector, water use has been reduced drastically in terms of GVA generation, meaning increased water-use efficiency, which influences the integrated computation shown in Figure 13.

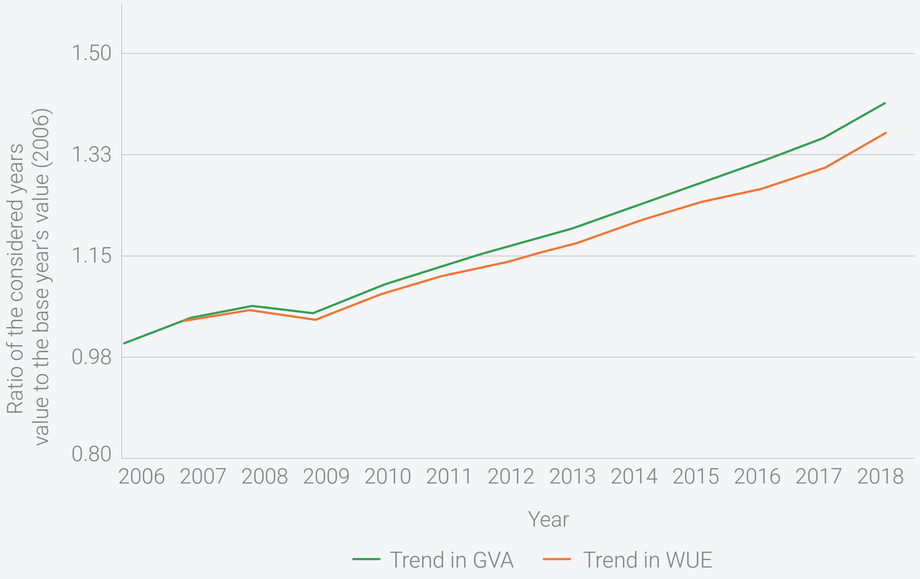
Comparing the growth of the GVA and water-use efficiency values provides insight on the sustainability of the economic growth, as detailed in sections 1.2 and 1.3 of this report. As the results in Figure 15 show, changes in water-use efficiency from 2006 to 2018 have grown at a faster rate than GVA, which may indicate that there is a lower risk of water becoming a limiting factor for economic growth that was not taking place in previous years.

Figure 15. Yearly change in gross value added and water-use efficiency values from 2006 to 2018 for the 86 countries



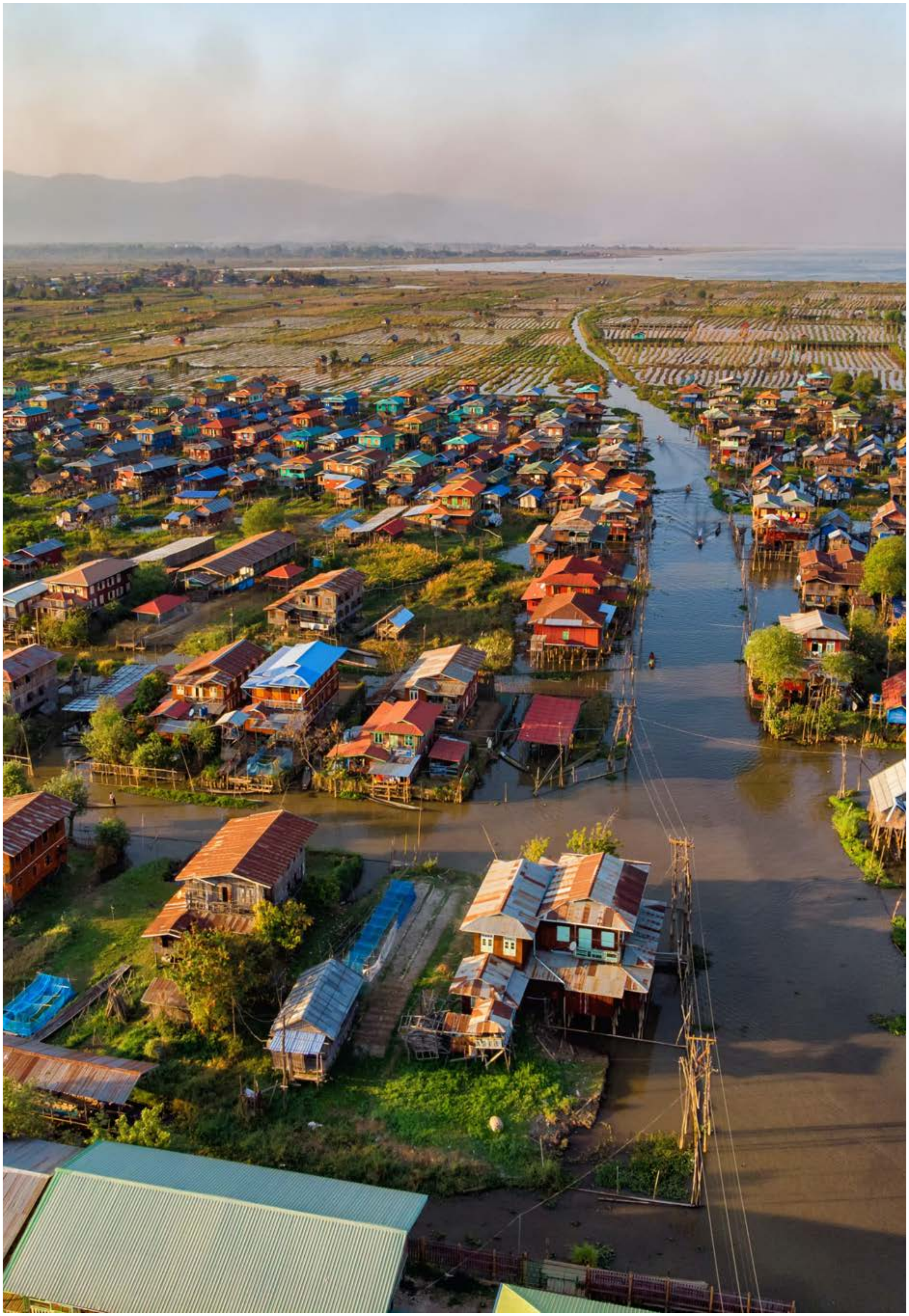
Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

Figure 16. Trend in gross value added and water-use efficiency values from 2006 to 2018 for the 86 countries (reference year = 2006)



Source: FAO IMI-SDG6 elaboration based on FAO. 2021.

However, as the overall trend in Figure 16 shows, GVA and water-use efficiency values are growing at a similar rate from the 2006 reference year, though water-use efficiency growth has been smaller, indicating that the sustainability of economic growth could still be jeopardized by its dependency on water resources.



Inle Lake, Myanmar by Yves Alarie ©Unsplash

4. Conclusions and recommendations

4.1. Interpreting the results

Indicator 6.4.1 is an economic indicator, which provides information on the economic performance of a country or economic sector, depending on water use. Water-use efficiency is the ratio between GVA and a volume of water used. An increase in water-use efficiency may therefore result from: i) a GVA increase; ii) a water-use decrease; iii) a combination of both trends; or, quite often, iv) a GVA that increases faster than water withdrawals. Decreases in water withdrawals may result from structural changes in a country's economy, such as industrial delocalization, which creates increases of virtual water imports.

The results in this report show that the change in water-use efficiency globally and for each of the three sectors included in the indicator's computation has a positive trend for 2015–2018, meaning that water-use efficiency is increasing. However, these data are not enough to answer the question of whether countries are on their way to decoupling economic growth from water use.

Nonetheless, there were complete data series on water withdrawals and GVA for 86 countries, which enabled a more accurate approximation to be performed to answer the question. In recent years, it seems that there has been a certain stability, or even a decrease, in the volume of water used by the economy to generate value added, indicating that a marginal increase in national income does not correspond to an equivalent or higher marginal increase in water use. These data may suggest a potential decoupling of 86 countries' economic growth and water use in the last few years, possibly driven by the industrial sector. This issue will be further analysed in the next reporting periods when more data are available. Data availability and accuracy are crucial for the computation of this indicator. In fact, data inaccuracy still represents a challenge for a proper interpretation of the indicator's results. Some countries should therefore report on water-use data more frequently, on an annual basis.

A very important issue to consider when interpreting the results is that **indicator 6.4.1 is a macroeconomic indicator based on aggregated country-level data**. While decoupling of water use from economic growth is important for a country's overall development, it should not prevent any economic implications for livelihoods from being considered. Further analysis should therefore be taken to determine what is happening at smaller scales in order to uncover who the lack of improvements in water-use efficiency within different sectors affects.

The indirect consequences, and sometimes the cause, of water-use efficiency increases are changes in the market chain and market diversification.

The main aim should be to use water for essential life purposes, including agriculture, and to make efforts to move economic growth to activities that are mainly not water dependent.

This does not mean moving water from one economic sector to another, which will most likely contradict other SDG indicators, but to increase the water-use efficiency within each of the sectors. Low economic efficiency values do not necessarily imply foregoing such water use (UN-Water, 2021).

The following sections explore the challenges and limitations of the monitoring process and interpretability of the change in water-use efficiency, and also provide some recommendations to accelerate an equitable increase in water-use efficiency, especially in countries that are more affected by unsustainable water use (as depicted by indicator 6.4.2).

4.2. Ongoing challenges for the development of the change in the water-use efficiency indicator

This indicator **does not aim to provide an exhaustive picture of countries' water use.** In fact, for adequate follow-up of target 6.4, indicator 6.4.1 must be combined with indicator 6.4.2 on water stress. Furthermore, the use of supplementary indicators at the country level, including the monitoring of irrigation, water distribution networks and industrial and energy cooling efficiencies, would enhance interpretations of the indicator's results.

Analysis of water-use efficiency by level of water stress and sustainability: The two indicators included in the target 6.4 monitoring process are complementary. Indicator 6.4.1 is an economic indicator, assessing the extent to which a country's economic growth is dependent on the use of water resources, while indicator 6.4.2 is an environmental indicator, tracking the physical availability of freshwater resources and the impact of water use. Decision makers can combine the information from these indicators to understand how increasing water use affects the availability of water resources, and to define a tipping-point target for decoupling water use from economic growth. Such information would enable countries to adequately follow-up on target 6.4.

To increase water-use efficiency, other challenges must be considered, such as how to reduce agricultural water withdrawals and how to scale-up technologies that reduce all sectors' water use. Focusing only on efficiency without considering other social, environmental or cultural factors could lead to undesired outcomes. It is therefore necessary to consider other SDG targets in an integrated manner to achieve sustainable economic growth.

One way of achieving this is to develop management instruments for sustainable and efficient water-use management. Such management instruments should include plans for the sustainable and equitable allocation of water, providing data and information for informed decision-making. However, under indicator 6.5.1, 45 percent of countries still report that their management instruments for sustainable and efficient water use are either ad hoc or have limited coverage across different users and areas of the country (UNEP, 2021). Urgent attention must therefore be given to water-use management in these countries.

The use and management of green water – i.e. rainwater stored in topsoil and evaporated, transpired or incorporated by plants – is not considered under the scope of this indicator. However, green-water resources could be used more efficiently to increase rainfed agricultural production, which could potentially help reduce the agriculture sector's reliance on irrigation.

Data collection: More data must be collected – ideally on an annual basis – to compute the indicator at the global level and for the different economic sectors, and to enable observations of regional differences. The main challenge for this indicator is therefore obtaining enough data to determine whether there are increases in value added per unit of water withdrawn, especially in the poorest regions.

Virtual water trade and water-use efficiency: Many water footprint studies and virtual water trade analyses indicate that some countries rely on external water sources to meet demands for food and manufactured products by importing goods whose production has a water footprint elsewhere. In fact, some academics and policymakers have considered virtual water trade as a solution to save water globally if production is moved from less water-stressed countries, such as Egypt and Saudi Arabia (Allan, 2003; Hoekstra, 2014). Decoupling should therefore not necessarily be pursued by all regions, but should be achieved where it is needed most (i.e. water-scarce regions or highly-stressed regions). 'Reversing' decoupling in more water-rich regions could be one particularly advantageous way to achieve this, with goods and services then exchanged through virtual water trade (UNEP, 2015).

In principle, this action should increase water-use efficiency. There is increasing concern about the virtual water trade-offs in terms of equity and sustainability, the energy-food nexus, and potential issues of market dependency, and, as a result, local food insecurity (Seekell and others, 2011). For these authors, the direction of virtual water flows is determined by the purchasing power of countries and sectors of the population, and not by their relative scarcity, thus counteracting decoupling efforts in water-scarce countries.

International trade of water, embedded in goods and services, may hide the link between economic growth and water use if virtual water is not considered.

4.3. Recommendations at the global level to accelerate water-use efficiency improvements

The United Nations has launched an initiative that involves all sectors of society to accelerate progress and support countries in achieving SDG 6 (UN-Water, 2020). The framework includes five accelerators (Figure 15):

1. Optimized financing with fully funded plans that result in services where they are needed most.

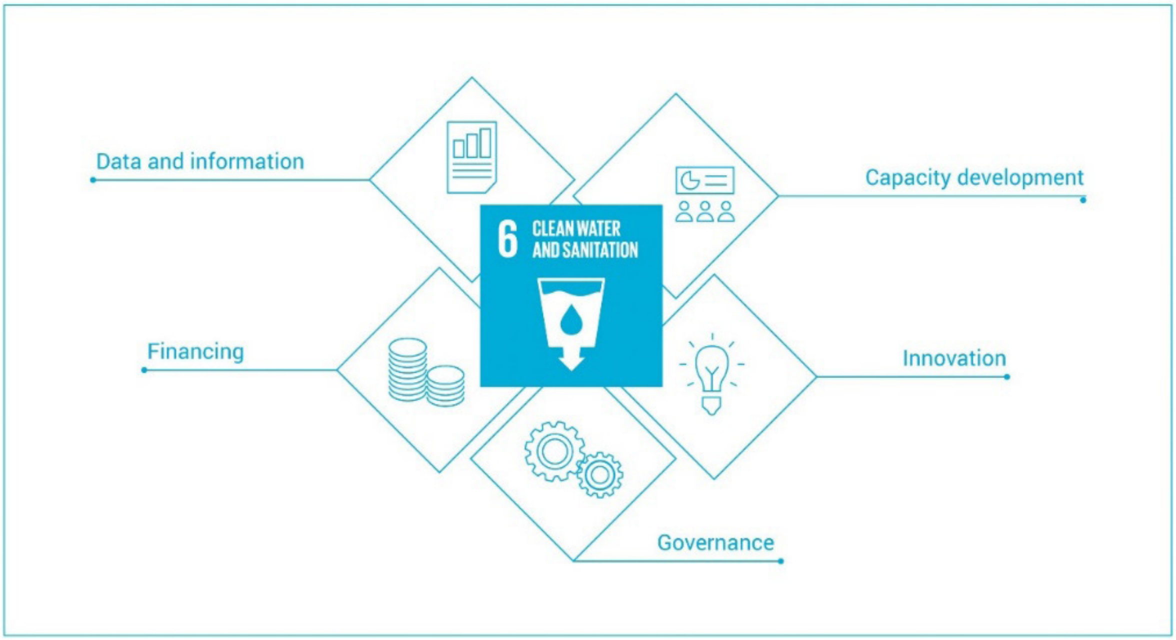
2. Improved data and information to inform decision-making and increase accountability.

3. Capacity-building of people and institutions to improve and expand services.

4. Innovation and the scaling-up of new practices and technologies.

5. Improved governance across sectors and national boundaries to share the responsibility of achieving SDG.

Figure 17. Key accelerators of the SDG 6 Global Acceleration Framework



Source: UN-Water (2020).

Improving water-use efficiency, especially in regions where water is scarcer and freshwater-dependent ecosystems are more compromised, while maintaining the view of an interdependent and globalized world, could be achieved faster if different actors, funding and resources are mobilized to transform how water is used and valued. The following sections propose recommendations and paths for action.

In line with the UN-Water statements (2021) on the values of water, the weight afforded to various values has a major impact on the values assessed and decisions taken. Though this report shows the results of an economic indicator, which are assessed from a macroeconomic perspective, practitioners must be acutely aware of the value system that they, and others, are adopting.

4.3.1. Addressing data gaps

- More frequent data should be collected to ensure an accurate interpretation of results.
- Supplementary indicators, including the monitoring of irrigation, municipal networks and industrial and energy cooling efficiencies, should be used at the country level to enhance the interpretation of this indicator.
- Research on the value of ecosystem services should be strengthened to integrate it into the economic growth equation (linked to indicator 6.6.1).

4.3.2. Mobilizing funding

- More investments should be made in the research and development of improved and additional technological tools for water-use efficiency gains.
- More investments should be directed towards improving water management in rainfed lands, following expert opinion that rainfed agriculture will remain a major source of food production in the coming decades (Rockström and others, 2010).
- Public expenditure should be increased to raise productivity, encourage diversification in food production and ensure that sustainable healthy foods are made abundantly available.

4.3.3. Innovating and scaling up best practices and technologies

- Innovation, both technical and non-technical, is key to reducing the pressure of a growing economy on available water resources. This should include technological tools, such as new techniques, solutions and approaches within the agriculture, municipal and industrial sectors, that are designed to reduce water consumption and use water more efficiently.
- This is particularly important in agriculture, the most water-demanding economic sector, where new crop varieties, efficient irrigation systems and improved rainfed cultivation could increase water-use efficiency, and links with efforts to achieve target 2.4.
- However, water accounting assessments should be carried out at the proper scale to avoid trade-offs and assumptions (Table 3) that would lead to ineffective measures. Accurate computations and observations improve knowledge over existing information that often takes a partial view of a phenomenon (FAO and World Water Council [WWC], 2018, p. 13).

Table 3. Environmental and engineering assumptions unpacked by water accounting

Assumption	How water accounting can provide a more accurate picture
Drip irrigation saves water and reduces consumption	In response to the savings initially produced by drip irrigation, farmers can change, extend and increase their crop area using those savings. This new crop area results in more water being consumed for irrigation, counteracting any drip irrigation water savings.
Healthy wetlands act as a sponge and increase water supply	Wetlands attenuate river flows, support base flows during drier periods and help recharge aquifers. However, wetlands also evaporate water and can therefore act as net water consumers. The hydrology of wetlands is specific to its characteristics and context, rainfall events and the nature of its changes.
Forests act as water towers and increase water for streamflow	Forests influence catchment hydrology in different ways depending on the type of vegetation, net transpiration and effects of rooting on soil infiltration rates. In South Africa, for example, some forests, which are especially composed of alien invasive species, are net water consumers and are removed or thinned.

Assumption	How water accounting can provide a more accurate picture
Upstream irrigation causes downstream shortages of water that reduce hydropower generation	The filling and drawdown of dams depend on many factors and not only changes to run-off caused by upstream irrigation. The volume of water held in dams is often surpassed by the volume of water generated by large catchments during monsoonal events.
Dams increase water supplies	Dams need to be positioned, sized and operated according to a number of criteria. In highly evaporative semiarid climates, these same design criteria can limit the usefulness of dams in supplying water downstream. Dams that are undersized in relation to downstream needs or to climate variability, or that are poorly managed (e.g. over-release of stored water) are 'constrained' in their ability to meet water needs during dry periods.
Rainwater harvesting creates additional water and 'greens' semiarid catchments	Carefully designed, positioned and maintained rainwater harvesting can improve the seepage of rainfall into soils and groundwater in situ. However, water captured by rainwater harvesting in upstream parts of a catchment can deplete water from downstream uses and cause problems for potable water supplies. Rainwater harvesting can potentially shift water consumption upstream, a phenomenon that all catchment stakeholders must discuss.

Source: FAO and WWC (2018).

4.3.4. Governance: roles of institutions and norms

- Besides providing an institutional framework for compliance with norms, governance arrangements should include coordination with other SDGs and integrated and nexus approaches, promote environmental commons stewardship, strengthen collaboration with the scientific community and establish sustainable consumption plans.
- The SDG 6 IWRM Support Programme assists governments in designing and implementing IWRM action plans as an entry point to accelerate progress towards the achievement of water-related SDGs and other SDGs, in line with national priorities. The IWRM Acceleration Package[8] is available to all countries to facilitate government-led multi-stakeholder processes to develop such action plans. The inclusion in this process of institutions with responsibility for sustainable and efficient water-use management will directly support action for target 6.4.
- The objective of this target is to reduce water stress by increasing water-use efficiency, especially in regions where economies are more vulnerable to water scarcity.
- Considering that water is such a basic human need, water allocations should be revised and, if necessary, prioritized according to where water produces goods and services that are most beneficial to society. Such measures should be balanced with protecting vulnerable groups, particularly the poor, as well as the environment, which needs water to keep ecosystems healthy.
- Ways to internalize current externalities should be considered, with sufficient funds assigned to ensure proper law enforcement in cases of pollution or overexploitation.

4.3.5. Capacity-building and awareness-raising to enhance water-use efficiency

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[8] See https://www.gwp.org/en/sdg6support/consultations/where-we-need-to-go/acceleration-package/.

Besides improving countries' capacity to lead the data preparation, collection and interpretation of indicator 6.4.1, other capacity-building, awareness-raising and education initiatives are also crucial to accelerating the overall success of target 6.4. These include:

- Promoting life cycle analysis and water footprint studies to understand where efficiency can be improved in each sector.
- Raising awareness of the need to reduce food loss, as estimates indicate that in terms of economic value, around 14 percent of global food is lost from post-harvest, up to, but not including, the retail level (FAO, 2019b).
- Promoting and incentivizing sustainable lifestyles, which could reduce the use of water in production (for example, of food, clothes, electronic equipment, furniture, cars), with sustainable diets in particular potentially able to reduce water use by about 20 percent compared with current diets (FAO, International Fund for Agricultural Development [IFAD], UNICEF, World Food Programme [WFP] and WHO, 2020). Sustainable diets are defined as those that are healthy, have a low environmental impact, are affordable and are culturally acceptable (FAO, 2010).
- Raising the general public's awareness of the importance of sustainable consumption through education, public information and promotional campaigns and food labelling.

Razmian, Qazvin Province, Iran by Saeed Sarshar ©Unsplash

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Annexes

Annex 1. AQUASTAT questionnaire

NATIONAL DATA					
0					
0.1.	**Water resources**				
011		**Unit**	**2016**	**2017**	**2018**
I	Total renewable water resources (long-term average)	10^9 m^3/ year			
I.1.	**Water withdrawals**				
111	**Water withdrawals by sector**	**Unit**	**2016**	**2017**	**2018**
1111	Total water withdrawal (1111 + 1112 + 1113)	10^9 m^3/ year			
11111	Agricultural water withdrawal: total (11111 + 11112 + 11113)				
11112	Water withdrawal for irrigation				
11113	Water withdrawal for livestock (watering and cleaning)				
1112	Water withdrawal for aquaculture				
1113	Municipal water withdrawal				
11131	Industrial water withdrawal (including water for cooling of thermoelectric plants)				
112	Water withdrawal for cooling of thermoelectric plants				
I.2.	Environmental flow requirements (stable over time)				
121	**Water withdrawals by source**	**Unit**	**2016**	**2017**	**2018**
1211	Total surface-water and groundwater withdrawal (freshwater) (1211 + 1212)	10^9 m^3/ year			
1212	Surface-water withdrawal				
122	Groundwater withdrawal				
123	Desalinated water produced				
124	Direct use of treated municipal wastewater				
II	Direct use of agricultural drainage water				
21	**Municipal wastewater**	**Unit**	**2016**	**2017**	**2018**
22	Produced municipal wastewater	10^9 m^3/ year			
23	Collected municipal wastewater				
III	Treated municipal wastewater				

III.1.	Irrigation and drainage	Unit	2016	2017	2018
311	**Area under agricultural water management**				
3111	Total agricultural water managed area (3111 + 3112 + 3113)	1,000 ha			
31111	Area equipped for irrigation: total (31112 + 31113 + 31114)				
31112	Area equipped for irrigation: part actually irrigated				
311121	Area equipped for full control irrigation: total (311122 + 311123 + 311124)				
311122	Area equipped for full control irrigation: part actually irrigated				
311123	Area equipped for full control irrigation: surface irrigation				
311124	Area equipped for full control irrigation: sprinkler irrigation				
31113	Area equipped for full control irrigation: localized irrigation				
31114	Area equipped for irrigation: equipped lowland areas				
3112	Area equipped for irrigation: spate irrigation				
3113	Cultivated wetlands and inland valley bottoms non-equipped				
III.2.	Flood recession cropping area non-equipped				
321	**Irrigated production**				
III.3.	Total harvested irrigated crop area (full control irrigation only)	1,000 ha			
331	**Drainage**				
IV	Area equipped for irrigation drained	1,000 ha			
41	**Environment**	**Unit**	**2018**	**2019**	**2020**

SDG INDICATOR 6.4.1 ON WATER-USE EFFICIENCY – COMPUTATION (in USD/m^3)

This worksheet is a tool to automatically calculate SDG indicator 6.4.1 on water-use efficiency. Please do not manually input information. No compilation is required as the worksheet is automatically filled in based on the data provided in the “National data” worksheet and some additional data (see table below). If the indicator is not calculated, too many variables are missing. Please check if more variables can be provided in the “National data” worksheet. Bright blue cells are calculated based on the automatically filled in grey blue cells.

Year: #N/D

IRRIGATED AGRICULTURE WATER-USE EFFICIENCY (A_{we})			**UNIT**	**CALCULATION RULES**
Ratio between rainfed and irrigated yields	[1]	0.000	decimals	AQUASTAT data (below) used if no data are entered
Proportion of irrigated land on the total arable land (A_i)	[2]	#N/D	decimals	=[3]/[4]
Irrigated land	[3]	#N/D	1,000 ha	
Cultivated land	[4]	#N/D	1,000 ha	
Proportion of agricultural gross value added produced by rainfed agriculture (C_r)	[5]	#N/D	decimals	=(1/(1+([2]/((1-[2])*[1]))))
Gross value added by the agriculture sector (excluding river and marine fisheries and forestry)	[7]	#N/D	USD (2015 price)	
Volume of water used by the agriculture sector (including irrigation, livestock and aquaculture)	[6]	#N/D	10^9 m^3	
Irrigated agriculture water-use efficiency	[8]	**#N/D**	**USD/m^3**	=([7]*(1-[5]))/([6]*1,000,000,000)
MIMEC WATER-USE EFFICIENCY (M_{we})				
Gross value added by the MIMEC sector (including energy)	[9]	#N/D	USD (2015 price)	
Volume of water used by the MIMEC sector (including energy)	[10]	#N/D	10^9 m^3	
MIMEC sector water-use efficiency	[11]	**#N/D**	**USD/m^3**	=[9]/([10]*1,000,000,000)
SERVICES WATER-USE EFFICIENCY (S_{we})				
Gross value added by the services sector	[12]	#N/D	USD (2015 price)	
Volume of water used by the services sector	[13]	#N/D	10^9 m^3	
Services water-use efficiency	[14]	**#N/D**	**USD/m^3**	=[12]/([13]*1,000,000,000)
WATER-USE EFFICIENCY				
Proportion of water used by the agricultural sector over the total water use	[15]	**#N/D**	decimals	=[6]/([6]+[10]+[13])
Proportion of water used by the MIMEC sector over the total water use	[16]	**#N/D**	decimals	=[10]/([6]+[10]+[13])
Proportion of water used by the services sector over the total water use	[17]	**#N/D**	decimals	=[13]/([6]+[10]+[13])
Water-use efficiency	[18]	**#N/D**	**USD/m^3**	=([15]*[8])+([16]*[11])+([17]*[14])

Additional data used in the computation of SDG indicator 6.4.1

Source	Variable	Unit	2016	2017	2018
UNSD	Agriculture, value added to GDP	USD current	0	0	0
	Industry, value added to GDP (MIMEC)	USD current	0	0	0
	Services, value added to GDP	USD current	0	0	0
FAOSTAT	GDP deflator (2015)	-	0	0	0
	Cultivated land (arable land + permanent crop)	1,000 ha	0	0	0
AQUASTAT	Ratio between rainfed and irrigated yields	%			0

SDG INDICATOR 6.4.2 ON WATER STRESS – COMPUTATION (in percentage)

This worksheet is a tool to automatically calculate SDG indicator 6.4.2 on water stress. Please do not manually input information. No compilation is required as the worksheet is automatically filled in based on the data provided in the “National data” worksheet and some additional data (see table below) as default values if missing. If the indicator is not calculated, too many variables are missing. Please check if more variables can be provided in the “National data” worksheet.

Year: #N/D

WATER STRESS			UNIT	CALCULATION RULES	
Total freshwater withdrawal (surface + groundwater)	[1]	**#N/D**	10^9 m^3	=[2]-[3]-[4]-[5] if missing from “National data”	
Total water withdrawal	[2]	#N/D	10^9 m^3	**#N/D**	
Desalinated water produced	[3]	#N/D	10^9 m^3		
Direct use of treated municipal wastewater	[4]	#N/D	10^9 m^3		
Direct use of agricultural drainage water	[5]	#N/D	10^9 m^3		
Total renewable freshwater resources	[6]	**0.000**	10^9 m^3	AQUASTAT data (below) used if no data are entered	
Environmental flow requirements (volume)	[7]	**0.000**	10^9 m^3	FAO and IWMI data (below) used if no data are entered	
Water stress	[8]	**#N/D**	%		=[1]/([6]-([7]/100))

Additional data used in the computation of SDG indicator 6.4.2

Source	Variable	Unit	2016	2017	2018
AQUASTAT	Total renewable freshwater resources	10^9 m^3/year			0
FAO and IWMI	Environmental flow requirements	10^9 m^3/year			0

Annex 2. Water-use efficiency country values, 2015–2018

Country	2015 (USD/m^3)				2018 (USD/m^3)				Percentage change 2015–2018			
	A_{we}	M_{we}	S_{we}	WUE	A_{we}	M_{we}	S_{we}	WUE	CA_{we}	CM_{we}	CS_{we}	CWUE
Afghanistan	0.1	26.4	53.2	0.8	0.1	31.0	57.3	0.9	2.5	17.7	7.7	9.7
Albania	1.6	15.8	20.4	8.4	1.7	23.1	31.6	10.3	4.4	46.4	54.6	23.4
Algeria	0.6	473.5	26.5	15.2	0.6	354.4	22.6	14.6	1.6	-25.1	-14.8	-3.9
Angola	0.2	200.9	178.8	149.2	0.2	194.6	167.7	142.0	1.3	-3.2	-6.2	-4.8
Antigua and Barbuda	1.5	65.5	137.6	100.6	1.9	110.8	150.2	118.4	25.5	69.2	9.2	17.7
Argentina	0.1	35.4	62.9	13.6	0.1	32.7	62.7	13.3	16.5	-7.7	-0.3	-2.2
Armenia	0.3	20.0	11.5	2.6	0.2	19.2	9.7	3.6	-21.8	-4.3	-15.7	36.6
Australia	0.4	89.6	220.0	65.3	0.4	91.8	406.3	70.2	12.9	2.5	84.7	7.4
Austria	3.0	32.0	347.2	96.3	3.3	35.2	369.3	103.4	10.0	10.1	6.4	7.3
Azerbaijan	0.3	7.8	41.6	3.9	0.2	50.2	46.5	3.9	-43.4	548.2	11.7	-0.1
Bahrain	0.7	846.5	67.3	71.8	0.6	1,009.5	71.1	78.1	-4.2	19.3	5.6	8.7
Bangladesh	0.7	64.5	30.4	5.1	0.8	85.3	36.3	6.2	9.3	32.3	19.3	21.6
Barbados	0.8	85.8	179.6	51.5	0.9	84.3	183.7	52.4	10.6	-1.8	2.3	1.9
Belarus	0.1	53.5	41.1	31.4	0.1	36.4	56.3	33.2	11.5	-31.9	37.1	5.6
Belgium	0.8	25.0	447.3	102.9	0.6	25.7	470.2	107.7	-25.5	2.9	5.1	4.7
Belize	0.2	8.7	96.1	12.8	0.1	7.6	107.7	13.8	-23.5	-12.6	12.1	8.3
Benin	0.3	60.1	25.2	23.5	0.3	68.1	33.1	29.4	28.7	13.4	31.6	24.9
Bhutan	0.4	185.4	62.9	5.2	0.6	225.4	73.9	6.3	33.2	21.6	17.4	20.0
Bolivia (Plurinational State of)	0.2	238.8	116.5	11.4	0.2	281.7	140.7	13.7	25.3	18.0	20.7	19.9
Botswana	0.1	139.7	94.5	67.7	0.1	194.5	97.5	74.5	25.7	39.2	3.2	10.0
Brazil	0.3	24.2	70.4	23.2	0.5	28.3	68.5	22.6	49.9	17.1	-2.7	-2.6
Bulgaria	0.1	2.5	35.5	7.4	0.1	2.7	41.9	8.6	6.6	9.9	17.9	16.3
Burkina Faso	0.1	128.2	14.1	9.9	0.1	148.9	16.9	11.8	14.9	16.1	19.8	18.5
Burundi	0.0	27.8	28.7	5.9	0.1	31.7	29.4	6.3	10.1	14.0	2.3	5.3
Cabo Verde	0.4	591.5	636.6	46.8	0.3	751.2	720.1	54.0	-31.3	27.0	13.1	15.4
Cambodia	0.3	148.4	74.4	5.9	0.3	213.6	90.9	7.6	2.0	44.0	22.1	29.4
Cameroon	0.0	70.3	66.9	22.0	0.0	81.6	74.7	24.8	10.1	16.0	11.6	13.0
Canada	0.4	12.2	215.4	39.8	0.4	12.8	235.2	42.4	11.2	5.1	9.2	6.4
Central African Republic	0.1	33.9	11.6	15.2	0.1	38.4	13.3	17.4	14.2	13.1	14.3	13.9
Chad	0.0	35.0	43.3	9.3	0.0	22.1	58.3	9.5	8.4	-36.8	34.5	2.6
Chile	0.1	33.2	115.3	2.4	0.1	42.5	123.2	2.4	2.7	28.0	6.9	0.5
China	2.0	34.1	69.4	18.1	2.2	43.7	93.2	23.5	11.7	28.3	34.4	30.3
Colombia	0.6	21.1	50.5	18.9	0.3	19.6	52.9	19.3	-56.9	-7.3	4.8	2.2

Country	2015 (USD/m^3)				2018 (USD/m^3)				Percentage change 2015–2018			
	A_{we}	M_{we}	S_{we}	WUE	A_{we}	M_{we}	S_{we}	WUE	CA_{we}	CM_{we}	CS_{we}	CWUE
Comoros	0.1	215.3	114.5	65.7	0.1	247.4	125.6	72.7	13.6	14.9	9.7	10.6
Congo	0.2	204.3	74.3	105.1	0.3	168.0	77.1	97.5	30.2	-17.8	3.7	-7.2
Costa Rica	0.4	37.9	59.0	15.2	0.4	45.9	196.1	22.4	15.0	21.2	232.4	48.0
Côte d'Ivoire	0.2	33.2	46.0	19.7	0.2	40.2	61.6	25.5	8.6	21.3	34.1	29.5
Croatia	0.6	46.1	65.3	53.7	0.7	49.6	74.3	60.1	15.2	7.7	13.9	11.9
Cuba	0.2	24.5	38.1	12.0	0.2	28.8	38.5	12.6	2.1	17.3	1.1	4.6
Cyprus	0.6	258.4	155.5	56.9	0.9	138.5	153.0	64.4	60.7	-46.4	-1.6	13.2
Czechia	1.1	59.9	176.1	102.3	1.2	66.4	186.4	113.7	9.8	10.8	5.9	11.1
Democratic People's Republic of Korea	0.4	5.9	6.6	1.7	0.4	5.2	6.7	1.7	3.3	-11.7	0.7	-4.5
Democratic Republic of the Congo	0.2	99.2	29.7	41.5	0.2	113.1	34.6	47.8	23.3	14.1	16.5	15.3
Denmark	0.8	1,548.7	528.4	320.3	1.1	1,262.7	555.8	262.2	39.9	-18.5	5.2	-18.1
Dominican Republic	0.2	26.8	49.4	6.7	0.2	32.1	58.5	8.0	16.9	20.0	18.4	18.8
Ecuador	0.7	54.9	40.6	8.9	0.6	57.5	41.9	9.2	-3.5	4.8	3.2	3.3
Egypt	0.6	91.2	17.0	4.4	0.7	22.1	18.1	4.6	14.6	-75.7	6.7	5.4
El Salvador	0.0	23.9	31.5	9.5	0.0	25.7	34.0	10.2	0.5	7.7	8.1	8.0
Eritrea	0.0	982.4	88.8	6.4	0.0	1,102.5	99.3	7.2	12.3	12.2	11.8	11.9
Estonia	0.1	3.1	251.8	12.2	0.1	3.5	269.5	13.7	8.3	13.1	7.0	12.2
Eswatini	0.1	68.1	50.6	3.4	0.1	66.1	57.2	3.6	-2.6	-3.0	13.1	6.3
Ethiopia	0.1	193.5	32.2	3.6	0.1	412.7	36.5	4.9	1.5	113.3	13.4	36.9
Fiji	0.2	66.2	103.4	38.4	0.3	74.7	115.5	43.1	52.7	12.7	11.7	12.0
Finland	0.6	35.5	372.6	108.9	0.4	38.9	391.1	113.3	-34.2	9.7	5.0	4.0
France	1.5	19.1	338.7	76.4	1.7	20.3	344.6	83.0	16.6	6.2	1.8	8.7
Gabon	0.2	479.5	70.1	91.4	0.2	477.1	76.7	95.1	16.8	-0.5	9.4	4.1
Gambia	0.1	10.0	17.9	9.4	0.1	10.0	22.3	11.2	1.8	-0.2	24.3	18.8
Georgia	0.6	9.3	17.7	8.6	0.8	13.7	17.1	10.8	36.0	47.3	-3.3	25.1
Germany	3.2	45.1	249.6	109.1	2.4	50.7	218.0	111.6	-25.9	12.4	-12.7	2.3
Ghana	0.1	152.1	68.7	24.4	0.1	182.5	87.6	29.9	6.4	20.0	27.5	22.1
Greece	0.5	170.4	96.6	17.2	0.5	74.7	85.8	17.1	4.8	-56.2	-11.2	-0.4
Guatemala	1.0	25.5	47.9	17.3	1.1	25.8	54.3	18.9	4.0	1.0	13.4	9.7
Guinea	0.0	38.2	18.4	7.8	0.0	53.5	21.3	9.1	10.0	40.1	15.9	17.5
Guinea-Bissau	0.1	10.3	11.4	2.8	0.1	12.2	12.8	3.1	18.5	18.7	12.8	14.4
Guyana	0.2	41.9	24.1	1.8	0.2	53.0	24.8	2.0	-18.7	26.4	2.8	8.1
Haiti	0.2	54.0	21.2	4.8	0.2	51.5	22.6	4.9	11.8	-4.5	6.8	2.5
Honduras	0.2	42.7	40.8	11.2	0.2	49.4	45.2	12.5	6.6	15.7	10.9	12.1

Country	2015 (USD/m^3)				2018 (USD/m^3)				Percentage change 2015–2018			
	A_{we}	M_{we}	S_{we}	WUE	A_{we}	M_{we}	S_{we}	WUE	CA_{we}	CM_{we}	CS_{we}	CWUE
Hungary	0.3	9.5	116.0	23.2	0.3	9.7	127.7	25.1	20.2	2.6	10.1	7.9
Iceland	0.9	13.0	145.5	51.1	0.9	15.7	171.9	60.6	0.7	20.8	18.1	18.6
India	0.4	31.5	19.3	2.4	0.4	37.9	24.5	3.0	11.8	20.4	27.4	23.3
Indonesia	0.2	31.7	16.7	3.5	0.2	42.1	18.8	3.9	-0.5	32.7	12.1	13.8
Iran (Islamic Republic of)	0.4	101.3	38.4	4.1	0.4	118.1	42.3	4.5	5.4	16.7	10.1	11.7
Iraq	0.1	37.9	81.6	4.7	0.1	53.7	78.1	5.4	-46.9	41.6	-4.2	14.5
Ireland	0.1	272.5	257.9	244.5	0.2	239.6	240.9	229.5	52.4	-12.1	-6.6	-6.2
Israel	1.9	487.2	235.1	125.7	1.6	567.3	271.2	139.0	-13.7	16.4	15.4	10.5
Italy	1.0	44.3	134.0	47.6	0.9	47.2	137.9	49.4	-3.4	6.7	2.9	3.6
Jamaica	1.3	4.9	43.7	14.2	1.7	2.3	65.8	8.9	29.3	-51.8	50.5	-37.5
Japan	0.7	103.9	213.3	54.5	0.7	106.7	224.9	56.7	7.0	2.7	5.5	4.0
Jordan	1.8	256.0	53.6	34.6	2.1	297.8	57.7	35.6	21.5	16.4	7.6	3.0
Kazakhstan	0.0	8.7	48.8	7.7	0.0	11.6	31.4	7.2	-18.3	32.6	-35.7	-6.5
Kenya	0.3	77.4	26.1	12.8	0.2	34.7	68.9	11.3	-21.1	-55.2	164.0	-12.1
Kuwait	0.9	2,606.6	156.8	113.6	0.7	2,873.7	134.1	102.1	-20.1	10.2	-14.5	-10.1
Kyrgyzstan	0.1	4.6	16.1	0.8	0.1	5.6	17.6	0.9	-6.7	21.7	9.4	10.5
Lao People's Democratic Republic	0.1	17.5	56.7	1.4	0.1	21.0	70.9	1.9	14.7	20.4	25.0	31.3
Latvia	0.0	128.2	198.8	129.5	0.0	149.1	222.4	140.7	-3.9	16.3	11.9	8.6
Lebanon	1.6	7.2	159.4	24.9	1.5	7.3	164.6	25.6	-7.6	1.2	3.3	2.7
Lesotho	0.0	32.8	72.6	48.1	0.0	33.4	75.6	49.7	-42.8	1.9	4.1	3.4
Liberia	0.0	4.0	5.9	4.7	0.0	4.1	5.6	4.6	11.2	2.4	-3.8	-1.9
Libya	0.0	33.5	6.8	2.4	0.0	59.6	12.1	4.3	78.0	78.0	78.0	78.0
Lithuania	0.0	52.8	197.1	93.9	0.0	175.1	214.2	156.8	3.9	231.5	8.7	66.9
Madagascar	0.1	12.6	14.8	0.7	0.1	17.4	15.8	0.8	4.6	38.2	6.5	13.3
Malawi	0.0	17.9	20.9	2.9	0.0	19.4	24.2	3.3	6.7	8.3	15.5	13.8
Malaysia	0.9	65.7	122.9	50.1	0.9	75.8	144.3	58.4	5.2	15.5	17.5	16.6
Mali	0.0	577.0	46.0	1.4	0.0	781.5	58.0	1.8	27.5	35.4	26.1	29.0
Malta	2.1	1,165.2	229.4	151.1	2.3	1,340.6	260.4	178.8	11.5	15.1	13.5	18.3
Mauritania	0.3	39.7	33.1	3.5	0.4	47.5	35.1	3.9	21.1	19.7	6.0	10.8
Mauritius	0.3	143.3	31.4	16.5	0.4	186.1	32.3	18.9	15.6	29.9	3.0	14.1
Mexico	0.3	42.5	58.7	12.6	0.2	41.9	59.8	13.0	-8.2	-1.4	1.9	2.9
Mongolia	0.3	37.8	77.7	21.7	0.3	29.2	125.1	22.9	-17.7	-22.7	60.9	5.7
Montenegro	52.6	5.8	27.6	19.4	47.3	7.9	30.6	21.9	-10.0	35.9	11.0	13.3
Morocco	0.4	114.3	49.4	7.7	0.5	126.4	56.6	8.7	9.7	10.6	14.6	13.2
Mozambique	0.0	96.4	21.6	7.1	0.1	151.2	20.9	7.9	19.2	56.8	-3.2	10.7
Myanmar	0.2	41.5	7.6	1.5	0.2	50.2	9.1	1.8	16.5	21.1	20.6	20.4
Namibia	0.1	224.8	96.7	35.5	0.1	220.5	96.8	35.3	21.8	-1.9	0.1	-0.5

Country	2015 (USD/m^3)				2018 (USD/m^3)				Percentage change 2015–2018			
	A_{we}	M_{we}	S_{we}	WUE	A_{we}	M_{we}	S_{we}	WUE	CA_{we}	CM_{we}	CS_{we}	CWUE
Nepal	0.6	89.4	71.2	2.0	0.6	101.1	85.9	2.2	-0.1	13.0	20.7	13.4
Netherlands	25.1	8.5	444.2	42.1	18.2	23.5	299.1	90.3	-27.4	175.8	-32.7	114.4
New Zealand	2.4	27.3	150.8	31.1	3.0	29.5	166.3	34.5	28.5	7.8	10.3	10.7
Nicaragua	0.2	38.9	23.1	6.3	0.2	39.7	25.5	6.8	1.0	1.9	10.1	7.5
Niger	0.0	57.7	24.1	3.4	0.0	52.6	25.3	3.7	87.3	-8.9	4.9	7.3
Nigeria	0.2	49.0	58.2	31.1	0.2	63.4	52.8	31.3	3.9	29.2	-9.1	0.4
North Macedonia	1.9	10.9	14.4	11.1	0.3	9.6	20.8	10.0	-85.9	-11.5	45.1	-9.7
Norway	0.8	103.4	284.1	124.6	1.0	109.8	266.6	120.8	28.9	6.1	-6.1	-3.0
Oman	0.9	159.4	336.6	36.3	1.0	139.5	411.2	37.9	4.8	-12.4	22.2	4.4
Pakistan	0.3	33.1	14.9	1.3	0.3	36.9	18.0	1.6	19.5	11.6	20.4	18.5
Palestine	5.4	79.6	50.9	32.3	5.1	87.6	52.6	34.1	-5.7	10.1	3.3	5.4
Panama	0.3	2,195.8	45.7	40.5	0.3	2,755.2	54.5	48.4	-10.1	25.5	19.3	19.5
Paraguay	0.1	60.7	57.3	12.6	0.2	69.2	64.4	14.2	25.7	14.1	12.4	13.0
Peru	0.7	247.2	40.9	10.7	0.7	722.7	115.4	11.9	-4.1	192.4	182.1	10.9
Philippines	0.2	8.1	21.3	3.2	0.2	6.1	23.2	3.6	11.3	-25.4	9.0	12.5
Poland	0.1	16.6	140.5	39.2	0.1	20.8	154.2	46.3	-20.6	25.5	9.7	18.0
Portugal	0.4	17.7	155.9	25.7	0.5	18.9	166.8	29.9	17.9	6.7	7.0	16.6
Puerto Rico	2.7	21.4	64.8	31.3	2.6	19.2	61.1	28.9	-3.5	-10.0	-5.7	-7.8
Qatar	1.1	801.6	161.5	206.3	1.3	2,930.5	120.3	200.8	14.5	265.6	-25.5	-2.7
Republic of Korea	1.6	104.2	130.0	49.7	1.6	115.5	137.5	53.8	2.9	10.9	5.8	8.2
Republic of Moldova	0.6	2.3	29.6	7.0	0.6	2.6	33.7	8.0	4.4	13.8	13.8	13.5
Romania	0.2	11.2	99.1	23.0	0.3	13.8	114.9	27.9	52.2	23.1	16.0	21.5
Russian Federation	0.1	13.0	48.9	18.8	0.1	14.9	47.1	19.3	-18.4	14.8	-3.8	2.7
Rwanda	0.1	62.5	66.6	29.3	0.1	71.9	81.4	35.3	26.7	15.0	22.3	20.6
Saudi Arabia	0.8	293.3	115.5	26.3	0.8	231.7	98.2	28.4	-3.7	-21.0	-15.0	7.8
Senegal	0.1	67.2	96.2	6.1	0.1	79.4	118.7	7.4	33.8	18.1	23.5	22.0
Serbia	0.1	2.4	30.9	6.0	0.2	2.2	36.1	5.9	41.0	-6.3	16.5	-1.6
Seychelles	7.2	33.1	112.1	83.3	8.4	38.6	130.6	97.1	16.6	16.6	16.5	16.5
Sierra Leone	0.1	3.2	13.1	7.7	0.1	4.5	14.3	8.7	15.3	41.0	9.5	13.0
Slovakia	2.1	102.4	184.9	139.9	0.5	110.3	199.3	138.3	-74.5	7.8	7.8	-1.2
Slovenia	4.5	14.7	155.8	40.5	6.5	15.9	168.0	42.9	43.4	7.7	7.8	5.8
Somalia	0.0	46.1	27.8	0.2	0.0	50.9	30.7	0.2	10.6	10.6	10.6	10.6
South Africa	0.1	20.0	55.1	14.9	0.1	17.2	51.1	14.3	-5.1	-14.1	-7.2	-4.2
South Sudan	0.0	24.3	36.4	19.0	0.0	31.3	31.7	20.0	-52.3	28.8	-12.7	5.4
Spain	0.4	32.9	180.2	33.7	0.5	37.2	187.2	36.8	16.5	12.9	3.9	9.1
Sri Lanka	0.2	25.3	58.5	5.4	0.3	28.1	64.6	6.1	52.7	11.0	10.4	11.8

Country	2015 (USD/m³)				2018 (USD/m³)				Percentage change 2015–2018			
	A_{we}	M_{we}	S_{we}	WUE	A_{we}	M_{we}	S_{we}	WUE	CA_{we}	CM_{we}	CS_{we}	CWUE
Sudan	0.2	137.2	46.7	2.3	0.2	160.3	56.9	2.6	-18.6	16.8	21.9	16.9
Suriname	0.9	7.8	57.5	6.9	1.1	10.4	50.5	7.1	30.0	33.2	-12.2	2.8
Sweden	3.6	72.7	358.7	185.5	3.7	79.8	381.1	198.5	3.2	9.6	6.2	7.0
Switzerland	3.9	197.6	530.3	344.9	4.2	176.7	566.3	339.7	6.6	-10.6	6.8	-1.5
Syrian Arab Republic	0.1	9.1	6.5	1.0	0.1	9.3	6.5	1.0	0.7	1.2	0.9	1.0
Tajikistan	0.2	2.0	4.4	0.7	0.2	2.2	5.4	0.9	16.3	13.4	20.8	31.3
Thailand	0.4	48.1	84.8	6.7	0.4	51.8	95.3	7.4	2.4	7.7	12.4	10.3
Timor-Leste	0.1	882.2	10.2	2.4	0.1	717.1	11.8	2.3	6.7	-18.7	15.1	-6.1
Togo	0.0	87.0	14.5	11.6	0.0	104.7	16.9	13.6	14.3	20.3	16.4	17.2
Trinidad and Tobago	2.8	68.4	64.3	63.0	2.5	68.6	56.3	58.1	-10.1	0.2	-12.3	-7.7
Tunisia	0.2	14.6	101.2	8.5	0.3	225.2	32.2	10.2	23.2	1,446.4	-68.1	19.8
Turkey	0.3	94.8	86.2	12.7	0.3	251.3	84.1	14.1	-7.7	164.9	-2.4	10.8
Turkmenistan	0.1	23.3	16.7	1.3	0.1	28.9	19.2	1.5	15.1	24.1	15.1	20.0
Uganda	0.0	85.4	39.2	26.9	0.0	102.1	47.4	32.4	6.9	19.6	20.9	20.6
Ukraine	0.1	4.1	19.8	6.9	0.0	4.8	22.0	6.6	-38.7	17.5	11.0	-4.3
United Arab Emirates	0.9	1,507.5	125.5	73.9	0.9	1,564.5	105.9	73.9	7.6	3.8	-15.6	0.1
United Kingdom	0.6	494.9	357.1	317.9	0.7	465.1	363.0	324.3	13.4	-6.0	1.7	2.0
United Republic of Tanzania	0.1	448.3	38.7	6.2	0.2	613.3	43.0	7.5	28.5	36.8	11.1	20.4
United States of America	0.2	14.7	256.2	40.7	0.2	15.9	274.6	43.6	-12.6	7.9	7.2	7.2
Uruguay	0.2	154.7	80.0	12.5	0.2	155.2	87.2	13.3	10.0	0.3	9.0	6.7
Uzbekistan	0.4	9.2	13.2	1.3	0.5	12.0	14.0	1.4	2.0	30.3	5.8	8.5
Venezuela (Bolivarian Republic of)	0.5	121.0	38.9	13.4	0.3	81.6	21.0	7.8	-45.7	-32.6	-46.0	-41.7
Viet Nam	0.4	18.1	70.9	2.1	0.4	22.3	89.9	2.5	4.1	23.6	26.9	22.0
Yemen	0.9	77.6	62.3	6.8	0.7	59.9	46.0	5.1	-18.0	-22.8	-26.1	-24.5
Zambia	0.0	49.4	43.7	12.2	0.0	53.6	48.0	13.3	-39.2	8.6	9.9	9.3
Zimbabwe	0.0	47.8	19.5	4.8	0.0	50.1	21.6	4.8	-4.0	4.9	10.9	0.7

Annex 3. Country data values, 2006–2018

86 selected countries

Country	2006 (USD/m^3)				2018 (USD/m^3)				2006 (km^3/year)			2018 (km^3/year)		
	A_{we}	M_{we}	S_{we}	WUE	A_{we}	M_{we}	S_{we}	WUE	V_a	V_m	V_s	V_a	V_m	V_s
Albania	0.7	8.4	7.5	4.9	1.7	23.1	31.6	10.3	0.5	0.2	0.5	0.7	0.1	0.2
Algeria	0.4	160.1	17.0	16.5	0.6	354.4	22.6	14.6	4.2	0.5	2.4	6.7	0.2	3.6
Armenia	0.4	22.3	3.6	2.3	0.2	19.2	9.7	3.6	1.9	0.1	0.8	1.9	0.1	0.7
Australia	0.4	95.4	156.7	50.5	0.4	91.8	406.3	70.2	11.0	2.4	4.2	12.0	3.0	2.3
Azerbaijan	0.2	5.7	8.7	2.3	0.2	50.2	46.5	3.9	8.1	3.4	0.8	11.2	0.5	0.4
Bahrain	0.3	467.1	56.4	55.5	0.6	1,009.5	71.1	78.1	0.2	0.0	0.2	0.1	0.0	0.3
Belarus	0.0	26.4	24.7		0.1	36.4	56.3	33.2	0.4	0.5	0.8	0.4	0.4	0.5
Belgium	0.9	14.8	384.6	57.8	0.6	25.7	470.2	107.7	0.0	5.5	0.7	0.0	3.2	0.7
Benin	0.2	48.3	26.3	21.2	0.3	68.1	33.1	29.4	0.1	0.0	0.1	0.1	0.0	0.1
Bosnia and Herzegovina		63.0	21.5			46.1	29.7		0.0	0.0	0.4	0.0	0.1	0.4
Botswana	0.0	110.6	52.2	43.3	0.1	194.5	97.5	74.5	0.1	0.0	0.1	0.1	0.0	0.1
Brazil	0.3	29.2	52.5	19.9	0.5	28.3	68.5	22.6	31.7	10.1	16.2	37.6	10.2	16.9
Bulgaria	0.1	2.0	23.6	5.1	0.1	2.7	41.9	8.6	0.9	4.6	1.0	0.7	3.8	0.9
Canada	0.4	10.9	151.7	30.1	0.4	12.8	235.2	42.4	2.5	32.9	5.8	2.6	28.1	4.9
Chile	0.0	14.5	69.9		0.1	42.5	123.2	2.4	29.4	4.7	1.3	97.0	1.7	1.3
China	1.2	17.8	30.0	8.6	2.2	43.7	93.2	23.5	366.4	134.4	69.4	385.2	133.5	79.4
Colombia	0.4	30.9	37.9	15.8	0.3	19.6	52.9	19.3	6.0	1.8	3.0	6.4	3.7	3.6
Costa Rica			36.1		0.4	45.9	196.1	22.4	0.0	0.0	0.7	2.0	0.2	0.2
Croatia	0.0	100.5	57.4		0.7	49.6	74.3	60.1	0.0	0.1	0.5	0.1	0.2	0.5
Cyprus	0.9	432.0	225.0	76.5	0.9	138.5	153.0	64.4	0.2	0.0	0.1	0.2	0.0	0.1
Czechia	1.2	40.0	129.6	72.3	1.2	66.4	186.4	113.7	0.0	1.2	0.7	0.0	0.9	0.7
Denmark	2.6	1337.3	443.4	352.0	1.1	1,262.7	555.8	262.2	0.2	0.0	0.4	0.6	0.1	0.4
Dominican Republic	0.2	39.2	33.8	6.7	0.2	32.1	58.5	8.0	4.7	0.3	0.8	7.6	0.7	0.9
Egypt	0.5	27.0	13.6	2.8	0.7	22.1	18.1	4.6	63.8	2.8	7.5	61.4	5.4	10.8
Estonia	0.1	3.5	182.3	11.8	0.1	3.5	269.5	13.7	0.0	1.5	0.1	0.0	1.5	0.1
Ethiopia	0.1	49.6	12.6	1.6	0.1	412.7	36.5	4.9	7.2	0.1	0.8	9.7	0.1	0.8
Finland	0.0	38.7	325.2		0.4	38.9	391.1	113.3	0.1	1.7	0.4	0.1	1.4	0.4
France	1.0	17.2	279.1	60.8	1.7	20.3	344.6	83.0	4.8	22.5	5.8	2.9	18.7	5.4
Georgia	0.4	3.8	16.8	4.4	0.8	13.7	17.1	10.8	1.1	0.4	0.4	0.5	0.2	0.6

Country	2006 (USD/m^3)				2018 (USD/m^3)				2006 (km^3/year)			2018 (km^3/year)		
	A_{we}	M_{we}	S_{we}	WUE	A_{we}	M_{we}	S_{we}	WUE	V_a	V_m	V_s	V_a	V_m	V_s
Germany	2.7	27.0	374.9	82.7	2.4	50.7	218.0	111.6	0.3	27.2	5.3	0.4	17.7	10.5
Ghana	0.1	85.9	45.7	16.8	0.1	182.5	87.6	29.9	0.8	0.1	0.2	1.1	0.1	0.3
Guinea	0.0	36.1	12.8	7.4	0.0	53.5	21.3	9.1	0.4	0.1	0.2	0.6	0.1	0.2
Hungary	0.4	6.6	85.5	17.8	0.3	9.7	127.7	25.1	0.3	4.4	0.8	0.5	3.4	0.6
Indonesia	0.2	9.4	16.0	2.8	0.2	42.1	18.8	3.9	132.1	23.2	14.9	189.7	9.1	23.8
Iraq	0.1	9.3	11.2	1.8	0.1	53.7	78.1	5.4	45.4	6.4	3.0	30.7	1.8	1.1
Ireland	0.0	701.9	170.7	197.9	0.2	239.6	240.9	229.5	0.1	0.1	0.7	0.1	0.5	0.8
Israel	2.0	364.7	208.3	100.8	1.6	567.3	271.2	139.0	1.1	0.1	0.7	1.2	0.1	0.9
Jamaica	0.3	15.2	33.9	13.5	1.7	2.3	65.8	8.9	0.5	0.2	0.3	0.1	1.1	0.1
Japan	0.6	90.5	191.2	50.5	0.7	106.7	224.9	56.7	54.7	12.7	15.8	53.7	11.0	14.6
Jordan	0.7	178.0	60.6	27.0	2.1	297.8	57.7	35.6	0.6	0.0	0.3	0.6	0.0	0.5
Kazakhstan	0.0	8.4	24.9	5.1	0.0	11.6	31.4	7.2	13.4	5.3	2.5	15.8	5.5	3.7
Kenya	0.1	63.4	27.6	10.6	0.2	34.7	68.9	11.3	1.8	0.1	0.8	3.2	0.3	0.5
Kuwait	0.4	2,644.6	87.5	98.7	0.7	2,873.7	134.1	102.1	0.6	0.0	0.4	0.8	0.0	0.4
Lao People's Democratic Republic	0.2	8.1	22.0	1.2	0.1	21.0	70.9	1.9	3.6	0.2	0.1	7.0	0.2	0.1
Latvia	0.0				0.0	149.1	222.4	140.7	0.1	0.0	0.0	0.1	0.0	0.1
Lebanon	1.1	16.5	67.4	21.5	1.5	7.3	164.6	25.6	0.8	0.2	0.4	0.7	0.9	0.2
Lithuania	0.0	5.7	147.9	16.3	0.0	175.1	214.2	156.8	0.1	1.6	0.1	0.1	0.1	0.1
Luxembourg	0.0	810.3	821.4		0.0	3,535.7	1,014.7		0.0	0.0	0.0	0.0	0.0	0.0
Malta	3.7	1,423.1	179.8	139.6	2.3	1,340.6	260.4	178.8	0.0	0.0	0.0	0.0	0.0	0.0
Mauritius	0.3	130.1	23.9	10.2	0.4	186.1	32.3	18.9	0.5	0.0	0.2	0.3	0.0	0.3
Mexico	0.2	44.2	55.8	12.0	0.2	41.9	59.8	13.0	59.4	7.2	10.7	67.3	8.5	13.1
Mongolia	0.2	9.8	22.9	8.2	0.3	29.2	125.1	22.9	0.2	0.2	0.1	0.3	0.2	0.0
Mozambique	0.0	40.4	14.7	4.7	0.1	151.2	20.9	7.9	0.8	0.0	0.3	1.1	0.0	0.4
Netherlands	24.5	14.1	384.0	55.2	18.2	23.5	299.1	90.3	0.1	9.9	1.3	0.3	5.8	2.0
Niger	0.0	23.0	9.7	3.2	0.0	52.6	25.3	3.7	0.7	0.0	0.3	1.5	0.0	0.2
North Macedonia	0.0	3.1	21.0		0.3	9.6	20.8	10.0	0.2	0.4	0.2	0.3	0.2	0.3
Norway	0.6	111.5	185.4	103.5	1.0	109.8	266.6	120.8	0.8	1.1	0.9	0.8	1.1	0.8
Oman	0.4	475.2	116.3	28.0	1.0	139.5	411.2	37.9	1.3	0.1	0.1	1.5	0.2	0.1
Palestine	2.5	44.8	27.3	17.3	5.1	87.6	52.6	34.1	0.2	0.0	0.2	0.2	0.0	0.2

Country	2006 (USD/m³)				2018 (USD/m³)				2006 (km³/year)			2018 (km³/year)		
	A_{we}	M_{we}	S_{we}	WUE	A_{we}	M_{we}	S_{we}	WUE	V_a	V_m	V_s	V_a	V_m	V_s
Panama		199.0	66.2		0.3	2,755.2	54.5	48.4	0.0	0.0	0.3	0.4	0.0	0.8
Peru			45.5		0.7	722.7	115.4	11.9	0.0	0.0	1.3	14.7	0.1	1.0
Philippines	0.1	7.2	18.0	2.1	0.2	6.1	23.2	3.6	65.6	7.5	5.8	68.0	16.1	9.6
Poland	0.1	10.7	96.5	25.7	0.1	20.8	154.2	46.3	1.1	8.2	2.1	1.4	6.5	2.1
Portugal	0.2	23.4	147.4	19.2	0.5	18.9	166.8	29.9	6.5	1.6	0.9	3.4	1.8	0.9
Qatar	0.3	4,789.5	102.3	139.4	1.3	2,930.5	120.3	200.8	0.3	0.0	0.2	0.2	0.0	0.6
Republic of Korea	1.4	75.5	87.9	35.4	1.6	115.5	137.5	53.8	16.0	4.5	7.0	16.0	4.5	6.7
Republic of Moldova	0.5	1.4	21.0	4.0	0.6	2.6	33.7	8.0	0.1	0.9	0.1	0.0	0.6	0.1
Romania	0.5	11.7	69.1	22.1	0.3	13.8	114.9	27.9	0.5	3.8	1.1	1.4	3.9	1.1
Russian Federation	0.1	8.7	46.3	14.6	0.1	14.9	47.1	19.3	12.8	38.3	13.0	18.6	27.7	17.3
Saudi Arabia	0.6	397.0	77.1	19.4	0.8	231.7	98.2	28.4	20.8	0.7	2.1	19.0	1.4	3.4
Serbia	0.0				0.2	2.2	36.1	5.9	0.1	0.0	0.0	0.7	4.2	0.7
Singapore	0.0	49.2	129.6		0.0	236.6	808.9		0.0	1.1	1.0	0.0	0.3	0.3
Slovakia	2.3	45.2	108.5	72.8	0.5	110.3	199.3	138.3	0.0	0.4	0.4	0.1	0.2	0.3
Slovenia	0.0	14.5	144.2		6.5	15.9	168.0	42.9	0.0	0.8	0.2	0.0	0.8	0.2
South Africa	0.2	48.1	39.9	16.1	0.1	17.2	51.1	14.3	8.7	1.3	4.0	11.5	4.3	4.1
Spain	0.4	41.4	124.8	28.8	0.5	37.2	187.2	36.8	23.2	7.0	5.9	20.4	6.0	4.9
Switzerland	0.0		423.0		4.2	176.7	566.3	339.7	0.1	0.0	1.0	0.2	1.0	0.9
Tajikistan	0.1	3.1	2.9	0.3	0.2	2.2	5.4	0.9	10.4	0.4	0.6	7.4	1.2	0.8
Tunisia	0.2	61.9	44.1	9.4	0.3	225.2	32.2	10.2	2.5	0.1	0.4	2.9	0.0	0.9
Turkey	0.3	106.9	59.3	11.7	0.3	251.3	84.1	14.1	32.2	1.3	5.2	51.7	1.1	6.6
Ukraine	0.1	4.0	17.6	5.8	0.0	4.8	22.0	6.6	4.5	7.2	3.3	4.7	4.1	2.5
United Arab Emirates	0.8	2,030.6	164.3	65.4	0.9	1,564.5	105.9	73.9	3.3	0.1	0.7	3.0	0.1	2.0
United Kingdom	0.5	309.8	304.9	258.2	0.7	465.1	363.0	324.3	1.4	1.6	6.2	1.2	1.0	6.2
United States of America	0.2	10.9	196.1	29.1	0.2	15.9	274.6	43.6	188.5	293.8	64.8	176.2	209.7	58.4
Uzbekistan	0.3	4.7	3.6	0.6	0.5	12.0	14.0	1.4	50.1	1.6	3.9	54.4	2.1	2.4
Zimbabwe	0.0	15.1	6.7	1.8	0.0	50.1	21.6	4.8	3.0	0.2	0.5	3.0	0.1	0.6

Annex 4. Basic documents and information resources

Food and Agriculture Organization of the United Nations (FAO). **SDG indicator 6.4.1 page:** http://www.fao.org/sustainable-development-goals/indicators/641/en/ (available in Arabic, Chinese, English, French, Russian, Spanish)

FAO. **SDG indicator 6.4.2 page:** http://www.fao.org/sustainable-development-goals/indicators/642/en/ (available in Arabic, Chinese, English, French, Russian, Spanish)

FAO. **SDG indicator 6.4.1 metadata**: https://unstats.un.org/sdgs/metadata/files/Metadata-06-04-01.pdf (available in English)

FAO. **SDG indicator 6.4.2 metadata**: https://unstats.un.org/sdgs/metadata/files/Metadata-06-04-02.pdf (available in Arabic, English)

FAO. **Step-by-step monitoring methodology for SDG indicator 6.4.1**: http://www.fao.org/3/ca8484en/ca8484en.pdf (available in Arabic, English, French, Russian and Spanish)

FAO. **Step-by-step monitoring methodology for SDG indicator 6.4.2**: http://www.fao.org/3/ca8483en/ca8483en.pdf (available in Arabic, English, French, Russian and Spanish)

FAO. **SDG indicator 6.4.1 e-learning course:** https://elearning.fao.org/course/view.php?id=475 (available in English and Russian; Arabic, French and Spanish forthcoming)

FAO. **SDG indicator 6.4.2 e-learning course:** https://elearning.fao.org/course/view.php?id=365 (available in English, French, Russian and Spanish; Arabic forthcoming)

FAO. SDG 6.4 monitoring sustainable use of water resources papers. **Change in Water-Use Efficiency Over Time (SDG Indicator 6.4.1). Analysis and Interpretation of Preliminary Results in Key Regions and Countries:** http://www.fao.org/3/ca5400en/ca5400en.pdf (available in English)

FAO. SDG 6.4 monitoring sustainable use of water resources papers. **The Agronomic Parameters in the SDG Indicator 6.4.1: Yield Ratio and Proportion of Rainfed Production: Guidelines for Calculation at Country Level for Global Reporting** (forthcoming)

FAO. SDG 6.4 monitoring sustainable use of water resources papers. **Incorporating Environmental Flows into "Water Stress" Indicator 6.4.2: Guidelines for a Minimum Standard Method for Global Reporting:** http://www.fao.org/3/CA3097EN/ca3097en.pdf (available in English and French)

FAO. **AQUASTAT database:** http://www.fao.org/aquastat/en/

FAO and UN-Water. **Progress on Water-Use Efficiency: Global Baseline for SDG Indicator 6.4.1, 2018:** http://www.unwater.org/publications/progress-on-water-use-efficiency-641/ (available in Arabic, Chinese, English, French, Russian, Spanish)

FAO and UN-Water. **Progress on Level of Water Stress: Global Baseline for SDG Indicator 6.4.2, 2018:** http://www.unwater.org/publications/progress-on-level-of-water-stress-642/ (available in Arabic, Chinese, English, French, Russian, Spanish)

International Water Management Institute (IWMI). **Global Environmental Flow Information System:** http://eflows.iwmi.org/ (available in English)

United Nations Department of Economic and Social Affairs (UN DESA). **International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 4**: https://unstats.un.org/unsd/publication/SeriesM/seriesm_4rev4e.pdf (available in Arabic, Chinese, English, French, Japanese, Russian, Spanish)

UN DESA. **System of Environmental-Economic Accounts for Water (SEEA-Water)**: https://seea.un.org/content/seea-water (available in Chinese, English, French, Russian, Spanish)

Learn more about progress towards SDG 6

6 CLEAN WATER AND SANITATION

Sustainable Development Goal (SDG) 6 expands the Millennium Development Goal (MDG) focus on drinking water and basic sanitation to include the more holistic management of water, wastewater and ecosystem resources, acknowledging the importance of an enabling environment. Bringing these aspects together is an initial step towards addressing sector fragmentation and enabling coherent and sustainable management. It is also a major step towards a sustainable water future.

How is the world doing on **Sustainable Development Goal 6**? View, analyse and download global, regional and national water and sanitation data: https://www.sdg6data.org/

Monitoring progress towards SDG 6 is key to achieving this SDG. High-quality data help policymakers and decision makers at all levels of government to identify challenges and opportunities, to set priorities for more effective and efficient implementation, to communicate progress and ensure accountability, and to generate political, public and private sector support for further investment.

The 2030 Agenda for Sustainable Development specifies that global follow-up and review shall primarily be based on national official data sources. The data are compiled and validated by the United Nations custodian agencies, who contact country focal points every two to three years with requests for new data, while also providing capacity-building support. The last global “data drive” took place in 2020, resulting in status updates on nine of the global indicators for SDG 6 (please see below). These reports provide a detailed analysis of current status, historical progress and acceleration needs regarding the SDG 6 targets.

To enable a comprehensive assessment and analysis of overall progress towards SDG 6, it is essential to bring together data on all the SDG 6 global indicators and other key social, economic and environmental parameters. This is exactly what the SDG 6 Data Portal does, enabling global, regional and national actors in various sectors to see the bigger picture, thus helping them make decisions that contribute to all SDGs. UN-Water also publishes synthesized reporting on overall progress towards SDG 6 on a regular basis.

Summary Progress Update 2021: SDG 6 – Water and Sanitation for All	Based on latest available data on all SDG 6 global indicators. Published by UN-Water through the UN-Water Integrated Monitoring Initiative for SDG 6. https://www.unwater.org/publications/summary-progress-update-2021-sdg-6-water-and-sanitation-for-all/
Progress on Household Drinking Water, Sanitation and Hygiene – 2021 Update	Based on latest available data on SDG indicators 6.1.1 and 6.2.1. Published by World Health Organization (WHO) and United Nations Children's Fund (UNICEF). https://www.unwater.org/publications/who-unicef-joint-monitoring-program-for-water-supply-sanitation-and-hygiene-jmp-progress-on-household-drinking-water-sanitation-and-hygiene-2000-2020/
Progress on Wastewater Treatment – 2021 Update	Based on latest available data on SDG indicator 6.3.1. Published by WHO and United Nations Human Settlements Programme (UN-Habitat) on behalf of UN-Water. https://www.unwater.org/publications/progress-on-wastewater-treatment-631-2021-update/
Progress on Ambient Water Quality – 2021 Update	Based on latest available data on SDG indicator 6.3.2. Published by United Nations Environment Programme (UNEP) on behalf of UN-Water. https://www.unwater.org/publications/progress-on-ambient-water-quality-632-2021-update/
Progress on Water-Use Efficiency – 2021 Update	Based on latest available data on SDG indicator 6.4.1. Published by Food and Agriculture Organization of the United Nations (FAO) on behalf of UN-Water. https://www.unwater.org/publications/progress-on-water-use-efficiency-641-2021-update/
Progress on Level of Water Stress – 2021 Update	Based on latest available data on SDG indicator 6.4.2. Published by FAO on behalf of UN-Water. https://www.unwater.org/publications/progress-on-level-of-water-stress-642-2021-update/
Progress on Integrated Water Resources Management – 2021 Update	Based on latest available data on SDG indicator 6.5.1. Published by UNEP on behalf of UN-Water. https://www.unwater.org/publications/progress-on-integrated-water-resources-management-651-2021-update/
Progress on Transboundary Water Cooperation – 2021 Update	Based on latest available data on SDG indicator 6.5.2. Published by United Nations Economic Commission for Europe (UNECE) and United Nations Educational, Scientific and Cultural Organization (UNESCO) on behalf of UN-Water. https://www.unwater.org/publications/progress-on-transboundary-water-cooperation-652-2021-update/
Progress on Water-related Ecosystems – 2021 Update	Based on latest available data on SDG indicator 6.6.1. Published by UNEP on behalf of UN-Water. https://www.unwater.org/publications/progress-on-water-related-ecosystems-661-2021-update/
National Systems to Support Drinking-Water, Sanitation and Hygiene – Global Status Report 2019	Based on latest available data on SDG indicators 6.a.1 and 6.b.1. Published by WHO through the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) on behalf of UN-Water. https://www.unwater.org/publication_categories/glaas/

UN-Water reports

UN-Water coordinates the efforts of United Nations entities and international organizations working on water and sanitation issues. By doing so, UN-Water seeks to increase the effectiveness of the support provided to Member States in their efforts towards achieving international agreements on water and sanitation. UN-Water publications draw on the experience and expertise of UN-Water's Members and Partners.

SDG 6 Progress Update 2021 – summary	This summary report provides an executive update on progress towards all of SDG 6 and identifies priority areas for acceleration. The report, produced by the UN-Water Integrated Monitoring Initiative for SDG 6, present new country, region and global data on all the SDG 6 global indicators.
SDG 6 Progress Update 2021 – 8 reports, by SDG 6 global indicator	This series of reports provides an in-depth update and analysis of progress towards the different SDG 6 targets and identifies priority areas for acceleration: Progress on Drinking Water, Sanitation and Hygiene (WHO and UNICEF); Progress on Wastewater Treatment (WHO and UN-Habitat); Progress on Ambient Water Quality (UNEP); Progress on Water-use Efficiency (FAO); Progress on Level of Water Stress (FAO); Progress on Integrated Water Resources Management (UNEP); Progress on Transboundary Water Cooperation (UNECE and UNESCO); Progress on Water-related Ecosystems (UNEP). The reports, produced by the responsible custodian agencies, present new country, region and global data on the SDG 6 global indicators.
UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS)	GLAAS is produced by the World Health Organization (WHO) on behalf of UN-Water. It provides a global update on the policy frameworks, institutional arrangements, human resource base, and international and national finance streams in support of water and sanitation. It is a substantive input into the activities of Sanitation and Water for All (SWA) as well as the progress reporting on SDG 6 (see above).
United Nations World Water Development Report	The United Nations World Water Development Report (WWDR) is UN-Water's flagship report on water and sanitation issues, focusing on a different theme each year. The report is published by UNESCO, on behalf of UN-Water and its production is coordinated by the UNESCO World Water Assessment Programme. The report gives insight on main trends concerning the state, use and management of freshwater and sanitation, based on work done by the Members and Partners of UN-Water. Launched in conjunction with World Water Day, the report provides decision-makers with knowledge and tools to formulate and implement sustainable water policies. It also offers best practices and in-depth analyses to stimulate ideas and actions for better stewardship in the water sector and beyond.

The progress reports of the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP)	The JMP is affiliated with UN-Water and is responsible for global monitoring of progress towards SDG6 targets for universal access to safe and affordable drinking water and adequate and equitable sanitation and hygiene services. Every two years the JMP releases updated estimates and progress reports for WASH in households, schools and health care facilities.
Policy and Analytical Briefs	UN-Water's Policy Briefs provide short and informative policy guidance on the most pressing freshwater-related issues that draw upon the combined expertise of the United Nations system. Analytical Briefs provide an analysis of emerging issues and may serve as basis for further research, discussion and future policy guidance.

UN-Water planned publications

- **UN-Water Policy Brief on Gender and Water**
- **Update of UN-Water Policy Brief on Transboundary Waters Cooperation**
- **UN-Water Analytical Brief on Water Efficiency**

More information: https://www.unwater.org/unwater-publications/

The global indicator on water-use efficiency tracks to what extent a country's economic growth is dependent on the use of water resources, and enables policy and decision makers to target interventions at sectors with high water use and low levels of improved efficiency over time.

This indicator addresses the economic component of target 6.4. In this report, you can learn more about the global and country progress on water-use efficiency. More information and methodological guidance can be found at: http://www.fao.org/sustainable-development-goals/indicators/641/

This report is part of a series that tracks progress towards the various targets set out in SDG 6 using the SDG global indicators. To learn more about water and sanitation in the 2030 Agenda for Sustainable Development, and the Integrated Monitoring Initiative for SDG 6, visit our website: www.sdg6monitoring.org

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