ESCWA Water Development Report 8

The Water-related Sustainable Development Goals in the Arab Region

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ESCWA Water Development Report 8

The Water-related Sustainable Development Goals in the Arab Region

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Executive Summary

The 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs) provide comprehensive, integrated and people-centred universal goals. The principle of sustainable development was officially introduced during the United Nations World Commission on Environment and Development in 1987. This principle was advanced through several United Nations frameworks and in 2002 the World Summit on Sustainable Development recognized the three dimensions of sustainable development: economic, social and environmental. In September 2015, the 2030 Agenda for Sustainable Development and its SDGs were endorsed. They aimed to achieve sustainable development in its three dimensions in a balanced, integrated and inclusive approach. The agenda encompasses 17 related goals and 169 targets as well as suggested means of implementation (MoI). One of these goals, SDG 6, is dedicated to water and sanitation, while the other goals are either implicitly or explicitly water related. SDG 6 comprises six targets and two MoIs measured against 11 indicators. The targets cover a wide range of water issues including drinking water and sanitation, wastewater management, water-use efficiency and water security, integrated water resources management (IWRM), shared water resources management and water-related ecosystems.

This study addresses SDG 6 and assesses the progress towards achieving its targets and indicators in the Arab region. The study also examines the linkages of SDG 6 to the other goals and provides some examples of the practical implementation of such linkages such as water-related ecosystems, water-food-energy nexus, economic value of water and others. In this context, it emphasizes how monitoring and implementing water-related SDGs targets and goals through national strategies and plans can assist in ultimately achieving water security in the Arab region. It highlights ways to deal with present and projected water scarcity at the regional and national levels by developing a set of scenarios and considering how SDGs targets and goals link with regional and national water strategies and action plans. The study also analyses how the water-related SDG targets and indicators guide the development of policy measures that tackle water challenges in the Arab region. Based on a thorough review of national water and sustainable development-related strategies, it was found that SDG interlinkages are relevant to all countries but must be adapted to the national context where governments can identify and assess those interlinkages.

There are many challenges facing the water sector in the Arab region that are, in turn, affecting the security of future water demands and needs. For instance, the inability to implement integrated water resources management plans, which includes securing shared water quotas, the rise in political conflicts as well as the impact of climate change, are among the main challenges that have escalated during the past decade. SDG targets and indicators can be adopted to

monitor these pressing factors and provide guidance on how to enhance management of water resources by the target year 2030.
To cope with these challenges, this report assesses policy interventions for the Arab countries based on better short- and medium-term forecasting of variations in water demand and supply to address future water shortages. Future water balance and scarcity scenarios for the period 2030-2050 were developed by making use of the climate change impact projections from the outcomes of Regional Initiative of Climate Change Impacts on Water Resources and Socio-economic Vulnerability of the Arab Region (RICCAR). These scenarios were compared to a no-action scenario through a detailed analysis of the projected hydrological parameters and variables as well as extreme climate indices. Proxy parameters were used for future water availability to explain how water supply and demands can be balanced in short- and medium-term water strategies. These scenarios were linked to relevant adaptation measures and strategies related to the water resources sector as well as the actions of 2030 Agenda for Sustainable Development already envisaged by the Arab countries in their national reporting and actions on the ground.

Proposed measures in these policy interventions include water-saving approaches as well as generation of additional water resources through the development of nonconventional water resources (such as desalination of sea and brackish water, reuse of drainage water, reuse of treated wastewater, storm water harvesting and groundwater recharge) were quantified and analysed to develop appropriate planning scenarios and decision support systems for planners and decision-making to optimize and rationalize water uses. Technological advancements have successfully supported the expansion of non-conventional water development applications which typically have lower energy demands and hence result in decreased treatment costs.

The climate forecasts generated for the period 2030-2050 for various climate change scenarios strongly indicate that some parts of the Arab region will be more vulnerable to worsening climate change conditions than others. In some of the identified Arab subdomains, including the Eastern Mashreq and the Mediterranean Coast, projected increase in run-off percentages was higher in summer compared to winter seasons, especially when the more pessimistic scenario was considered. Forecasts of winter water shortages were higher than those in summer, notably in the Atlas Mountains and the Western Mashreq.

The forecast percentage change in surface water run-off were used as a proxy for assessing water availability across the Arab domain and available water volumes were estimated in various subdomains for different climate change scenarios. Additional information related to variations in extreme weather indices were also considered for a better understanding of the impacts of climate change on water supply in the region until the period 2030-2050. The results showed that drier winters and increased incidence of flash floods and surface run-off during the summer season are envisaged. In many subdomains the moderate climate change scenario generated increasing run-off forecasts compared to the baseline values. Higher resolution studies need to be conducted in these subdomains using high resolution national and local data to better assess and validate the estimate of water volumes for building, for instance, small- and medium-sized dams for efficient water harvesting of surface run-off taking into account the analysis of extreme climate indices as demonstrated in this study.

The above findings can be used to inform operational plans in water strategy that consider SDG interlinkages. This approach will assist country planners to develop optimization methods of water allocation among the three key domains (agricultural, industrial and domestic) and to adopt water resources management tools and decision support systems that can directly inform relevant targets and indicators of SDG 6 (namely targets 6.1, 6.3, 6.4 and 6.5). For instance, hydrological modelling outcomes generated under RICCAR were used to understand the changes in water availability by mid-century in terms of runoff and river discharge. This information would support the assessment of water-related SDGs in the Arab region such as indicator 6.4.2 on level of water stress: freshwater withdrawal as a proportion of available freshwater resources.

The report also provided insights on the institutional mechanisms for monitoring and implementing water-related SDGs on the global, regional as well as national levels. The High-level Political Forum (HLPF) and Arab Forum for Sustainable Development (AFSD) are the processes under which the progress towards the 2030 Agenda is reviewed through the Voluntary National Reviews (VNRs). SDG 6 was one of the goals reviewed in 2018. The report also provided a mapping of national development strategies and water sector plans and provided country-specific case studies for linking national targets and indicators with those of water-related SDGs. Moreover, mainstreaming gender measures in water and sanitation and related goals, as well as in national strategies and plans, are addressed. Many Arab countries have acknowledged the importance of women's involvement in water-related issues and thus are currently on their way to implement strategies in order to move towards gender equality and women's empowerment, especially through involvement in decision-making policies and assessing how women should be given priority in water-related issues. Several case studies were shown in the report on gender mainstreaming for incorporating women's needs in national strategies and water-related programmes as a key step towards achieving sustainable development at large. Finally, the need for localizing water-related SDG targets and indicators is discussed to bring them in line with national strategies and plans in order to enable coping with water challenges in the region.

There is a need for effective institutions to build on the linkages between different sectors to achieve water security and the water-related goals and targets through a multi-stakeholder approach. Also, effective actions need to be taken at different levels of intervention to enhance existing institutional and implementation mechanisms and develop innovative solutions to achieve water-related goals and targets based on regional, national and local circumstances.

The report recommends an institutional framework that would help the countries implementing water accounting through an integrative and intersectoral approach that includes different institutional stakeholders in relation to the water sector. Ultimately, water accounting will help in tracking sustainable development since water interlinks all the different SDGs. The national governments need to determine which institutional stakeholders will be specifically involved; for example, ministries or local institutional stakeholders can be removed or added to the framework proposed in this report. The framework can be as sophisticated as a country needs, and it aims to be flexible with the existing institutional structure. This framework can also identify the gaps in data and indicators as well as ensuring the reliability of data from multiple institutions. In some cases, the data would be available but not measured against a specific indicator; in other cases, a global indicator may be required but the data is not available. Thus, it is the responsibility of the national government to carry out an assessment to prioritize indicators and data needs based on its local and national circumstances. That said, in some Arab countries different frameworks may already be in place to monitor the SDGs. For instance, a sustainable development unit could be operationalized in each sector to track progress on the respective SDGs targets and indicators or it could be placed in any of a number of ministries.

Arab countries should encourage investments in the water sector and public-private partnerships can be an option depending on what approach a government prefers. There should be an enabling institutional environment to encourage mobilization of such investments. Again, countries should explore the different financial options and opportunities for the water sector. In addition, institutional, financial, human and technical capacities should be strengthened and coordinated at national, subnational and local levels. Furthermore, capacity-building programmes and activities should be implemented through an integrated approach that covers all of these aspects in order to optimize decision-making through the water sector. The optimization of resources through coordinated capacity-building would thus lead to a more efficient utilization of these resources in sectoral and national development plans. SDG interlinkages provide a foundation to develop capacities and thereby should be mainstreamed in national monitoring systems. Nevertheless, there are gaps in data collection and monitoring which can be resolved through enhancing capacities of experts at the line ministries as well as national statistics offices. For example, water accounting can be capacitated as one of the instruments or tools that can resolve data gaps not only in the water sector, but across the main socioeconomic sectors as water has proved to be central throughout the 2030 Sustainable Development Agenda.

The main recommendations of this report are to encourage efforts to:

- Assess water-related SDGs in order to select priority targets and indicators according to national circumstances and needs and that are most relevant to a country’s sustainable development agenda. This would require setting out new targets or adjusting existing targets and indicators to measure progress towards national as well as global goals;
- Adjust existing national institutional settings and make use of the proposed institutional framework in this report to adjust the role and mandate of national institutions and concerned units for successful monitoring and implementation of SDGs and mainstreaming related targets and indicators in national water policies and strategies;
- Develop local and national institutional capacities to mainstream the SDGs in national development strategies and plans and to integrate them within the national reporting and monitoring processes in order to efficiently use the available resources;
- Strengthen the capacities of statistical institutions to enable the utilization of existing tools for data monitoring, analyses and integrating water accounting in the reporting and implementation systems of SDGs;

- Engage local communities and civil society in data collection and implementation process of water-related SDGs in order to produce more comprehensive data accounts that would help inform national water policies;
- Ensure gender mainstreaming in water and sanitation and related goals as well as in national strategies and action plans and engage all stakeholders such as youth, local actors, vulnerable groups, etc., through decentralized entities and constituents of the proposed institutional structure for implementation of SDGs at the national level;
- Maximize the utilization of non-conventional water resources and advance related technologies to bridge the gap between supply and demand, which also plays a key role in the projection of future water balance at various levels (including small areas and catchments) within the context of implementation of SDG 6 targets and indicators;
- Utilize future projected climate scenarios based on RICCAR to inform operational plans in water strategy that considers SDG interlinkages. This approach will assist country planners to develop optimization methods of water allocation among the key sectors and to adopt water resources management tools and decision support systems that can directly inform relevant targets and indicators of SDG 6;
- Encourage investments in research and technology; especially the research involved in adapting and developing technologies to cope with climate change impacts and water scarcity in the region;
- Engage the science and technology communities in the national SDGs implementation process, as science and technology are strategic means of implementation of the science-policy interface that informs evidence-based decision-making.

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Acronyms

ADC	Adsorption desalination and cooling
AFSD	Arab Forum for Sustainable Development
bcm	Billion cubic metres
BOT	Build-operate-transfer
CSP	Concentrated solar power
DEWA	Dubai Electricity and Water Authority
EBM	Ecosystem-based management
ESCWA	Economic and Social Commission for Western Asia
FAO	Food and Agriculture Organization of the United Nations
GCC	Gulf Cooperation Council
GCMs	Global circulation models
GDP	Gross domestic product
GEMI	Integrated monitoring of water and sanitation-related SDG targets
GLAAS	UN-Water Global Analysis and Assessment of Sanitation and Drinking Water
HLPF	High-level Political Forum
HYPE	Hydrological predictions for the environment
IAEG-SDGs	Inter-agency and Expert Group on the Sustainable Development Goal Indicators
IPCC	Intergovernmental Panel on Climate Change
iSDG	SDG interlinkages
IUCN	International Union for the Conservation of Nature

IWRM	Integrated water resources management
JMP	Joint monitoring programme
KAUST	King Abdullah University of Science and Technology
KISR	Kuwait Institute for Scientific Research
MAR	Managed aquifer recharge
mcm	Million cubic metre
MENA	Middle East and North Africa region
NDCs	Nationally determined contributions
NGOs	Non-governmental organizations
NRW	Non-revenue water
NUS	National University of Singapore
NWRP	National Water Resources Plan
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
PPP	Public-private partnerships
PV	Photovoltaic
RCM	Regional climate modelling
RCP	Representative concentration pathway
RICCAR	Regional Initiative for the Assessment of Climate Change Impacts and Socioeconomic Vulnerability in the Arab Region
RO	Reverse osmosis
SDG-PSS	SDG Policy Support System
SDGs	Sustainable Development Goals
SDII	Simple Precipitation Intensity Index
SDS	Sustainable development strategy

SEEA	System of Environmental-Economic Accounts
SEEAA	SEEA-Agriculture
SEEAE	SEEA-Energy
SEEAW	SEEA-Water
SWCC	Saline Water Conversion Corporation
DESA	United Nations Department of Economic and Social Affairs
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-IHP	UNESCO Intergovernmental Hydrological Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-Habitat	United Nations Human Settlement Programme
UNICEF	United Nations International Children's Emergency Fund
UNWCED	United Nations World Commission on Environment and Development
UN-Women	United Nations Entity for Gender Equality and the Empowerment of Women
VIC	Variable infiltration capacity
VNRs	Voluntary National Reviews
WAU	Water accounting unit
WHO	World Health Organization
WUE	Water-use efficiency
WWTP	Wastewater treatment plant

Introduction

The 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs) provide a comprehensive, far-reaching and people-centred set of universal goals. The 2030 Agenda aims to achieve sustainable development in its three dimensions – economic, social and environmental – in a balanced and integrated manner while pledging to leave no one behind. The agenda comprises 17 interconnected goals and 169 targets, in addition to suggested means of implementation. While the 2030 Agenda has one goal dedicated to water (SDG 6), many other goals are either implicitly or explicitly water related.

SDG 6 is dedicated to clean water and sanitation and embraces six targets and two means of implementation (MoI) measured against 11 indicators. The targets cover a wide range of water issues including drinking water and sanitation, wastewater management, water-use efficiency, integrated water resources management (IWRM) and shared water resources cooperation. Water-related ecosystems and resource quality are also considered key targets to be fulfilled under the SDG 6 by 2020 while all other targets are aimed to be achieved by 2030.

There are many challenges facing the water sector in the Arab region that are affecting water security and the ability to secure future water demands and needs among competing sectors. In addition to this, the inability to implement integrated water resources management plans, including securing shared water quotas, the rise of associated conflicts as well as the impact of climate change are the main other pressures on the already scarce water resources in the region. SDG targets and indicators can be adopted to monitor these pressing factors and to provide guidance on how to enhance management of water resources by the target year 2030. There is a need for policy interventions based on better short- and medium-term forecasting of variations in water demand and supply for the Arab countries. This will help address future shortages and to develop appropriate planning scenarios and decision support systems to optimize water allocations for various functions. Proposed measures should address both the demand and supply sides to ensure a balance through lowering the demand and availing more nonconventional water resources. It should also be noted that the research efforts that have been undertaken so far on this important subject have not adequately taken the climate change scenarios into account, hence they will be looked at closely in this report.

Objectives of the study

This report addresses how monitoring and implementing measures to achieve water-related SDGs and their targets through national strategies and plans can assist in achieving water security in the Arab region. The report suggests ways to deal with present and projected water scarcity at the regional and national levels by developing a set of scenarios and considering how SDGs and their targets could link with regional and national water strategies and action plans. An institutional framework for assisting countries to advance progress on linking SDGs to national strategies and action plans is proposed. The report also analyses the SDG targets and indicators related to water among the 17 SDGs and will investigate how those can guide the development of policy measures that tackle water challenges in the Arab region, particularly water security.

There is a focus on how these water targets reflect in national policies and if SDG 6 can assist water planners and decision-makers in ministries of water resources to monitor their operational plans in comparison to the traditional ways of monitoring performance indicators for various subsectors.

Future water balance and scarcity scenarios up to 2040 are developed and presented in this report, making use of the climate change impact projections from the outcomes of the Regional Initiative for the assessment of Climate Change Impacts on Water Resources and Socio-economic Vulnerability in the Arab Region (RICCAR) and compared to a “no-action” scenario. These scenarios are linked to relevant adaptation measures and strategies related to the water resources sector as well as the stipulated actions of 2030 Agenda for Sustainable Development already envisaged by the Arab countries in their national reporting and actions.

To cope with expected future water scarcity there is an utmost need for expansion of the use of non-conventional water resources and efficiency improvements to achieve SDG 6. Still, questions remain whether countries can cope with water scarcity by improving water-use efficiency and/or increasing the utilization of non-conventional resources such as desalination of sea and brackish water, reuse of drainage water, reuse of treated wastewater, storm water harvesting and groundwater recharge and how water scarcity can be assessed based on different socioeconomic and environmental scenarios and projections in the future. This report attempts to answer these questions through a detailed analysis of the projected hydrological parameters and variables, as well as extreme climate indices and proxies, to explain how water supply and demand can be balanced in short- and medium-term water strategies.

The report also provides explanations for how the Arab region can achieve water security through the achievement of the water-related SDGs in light of escalating water scarcity concerns and increased pressures on water resources due to climate change, conflict, population movements, tensions over shared water resources, governance and institutional settings, and how this can help achieve universal access to water supply and sanitation in the Arab region. In other words, how can national efforts to monitor the water-related SDG targets and indicators help cope with challenges of water resources management in both regional and national contexts? Can a nexus perspective support this effort?

Finally, the report will develop an institutional framework that would help countries achieve the water-related SDGs by 2030, embracing the key components and institutional settings needed at the national level.

Methodology and approach

This is the eighth issue of the Economic and Social Commission for Western Asia (ESCWA) Water Development Report examining water-related SDGs from the perspective of water security and water scarcity in the Arab region. In doing so, the publication focuses on addressing the availability of water resources used by different sectors, with a focus on water-use efficiency and the development of non-conventional water resources, following a science-based approach in analysing the projected impacts of climate change on water resources and related scientific outputs within the context of the 2030 Agenda. In doing so, the report explores opportunities and challenges associated with increasing the contribution of non-conventional water resources to counteract freshwater scarcity, with a particular focus on maximizing the utilization of resources such as the reuse of treated drainage and wastewater, desalination of brackish and sea water, storm water harvesting and groundwater recharge based on actual volumes estimated for different climate change scenarios.

Regional specificities and experiences are highlighted to assist countries in achieving water-related SDGs. The publication proposes innovative approaches to ensuring water security in the Arab region by developing a framework to help countries pursue the implementation of the SDGs by 2030 in tandem with objectives laid out in national water policies and strategies. Institutional mechanisms at the regional and national levels are examined while taking into consideration a rights-based approach to pursuing the water-related SDGs.

The publication also explores the possibility of increasing the role of integrated water resources management (IWRM) through the utilization of non-conventional water resources to deal with water scarcity in Arab countries and identifies best practices from the region. Many countries that have recognized this approach are currently adopting innovative techniques to make the best use of their available water resources. The report also provides a framework for adopting these new policies and approaches in the water sector within the context of monitoring and implementing water-related SDGs.

All three pillars of sustainable development are addressed in this publication. For instance, water supply and sanitation have social, economic and environmental dimensions. Ensuring water security in a water-scarce Arab region must be grounded in inclusive and integrated socioeconomic and environmental assessments, policies and measures. For example, reallocation of water resources from agriculture to drinking and industrial uses will have significant social implications on labour in the agricultural sector, women farmers, etc., and will affect the contribution of different sectors in the gross domestic product (GDP) in the concerned countries.

This report also adopts rights-based approach to the access to water and sanitation services in pursuit of water-related SDGs. The premise of water security is based on access to water and sanitation is a human right. In addition, the publication aims to suggest ways in which Arab States and stakeholders might draw upon the water-related SDGs to help address key challenges in water security in the Arab region, particularly with respect to selected targets and means of implementation related to water scarcity, water-use efficiency and the use of non-conventional water resources. This report targets government officials, policy advisors and decision-makers, experts in water resource management, climate change experts and negotiators, planning officials responsible of monitoring the SDGs and national statistical offices.

Structure and contents

This publication addresses how monitoring and implementing water-related SDGs targets and goals will assist in dealing with current and future water scarcity challenges. It introduces innovative approaches to cope with water scarcity at the regional and national levels by integrating SDG targets and goals into the regional action plans and national water resources strategy measures and by developing the required institutional set-ups to achieve this integration. The introduction includes the study's background, objectives, methodology and contents. Chapter 1 addresses the water-dedicated SDG 6 and its linkages with other goals and targets. Chapter 2 includes the challenges faced by the water sector and in achieving the SDGs in the Arab region. Chapter 3 analyses the changes forecast in water supply and aims to provide an estimated water supply gap in the context of climate change impacts until the year 2040. Chapter 4 provides insights on the institutional mechanisms for monitoring and implementing water-related SDGs on the global, regional as well as national levels. This chapter also maps national development strategies and water sector plans and provides national case studies for linking sector-based national targets and indicators with those of water-related SDGs. Finally, Chapter 5 includes means of implementations to achieve the water-related goals and targets as well as key messages and recommendations of the study.

Overview of SDG 6 and Linkages with Other SDGs

1. Overview of SDG 6 and Linkages with Other SDGs

The concept of sustainable development was initially presented during the United Nations World Commission on Environment and Development in 1987 as “development that meets present needs without compromising the ability of future generations to meet their own needs”. This principle later evolved through a series of United Nations frameworks, and in 2002, at the World Summit on Sustainable Development, the economic, social and environmental pillars of sustainable development were espoused.

This chapter will address the SDG 6 and its linkages to the other goals while focusing on the Arab regional context. Synergies between policy interventions to advance one SDG that would lead to accompanying benefits in other SDGs will be discussed. It will identify the water-related SDGs and discuss some of the prominent interlinkages that are crucial for the water resources sector to implement coherent policies. Qualitative analysis of these interlinkages will be also discussed in this chapter.

A. Overview on targets and indicators of SDG 6

SDG 6 is comprised of six targets and two means of implementation (MoI), whose progress is measured according to 11 indicators (table 1). The targets are related to various aspects of water including drinking water, sanitation, wastewater, water-use efficiency and water stress, integrated water resources management (IWRM) and transboundary cooperation and water-related ecosystems. The aim is to achieve these targets by the year 2030, except for target 6.6 on water-related ecosystems which has a 2020 target due to its linkages with a multilateral environmental agreement on biodiversity.

In order to globally monitor the different water-related targets and indicators, UN-Water launched the Integrated Monitoring Initiative for SDG 6 (GEMI), which builds upon and expands the experience and lessons learned during the implementation period of the Millennium Development Goals which ran from 2000 to 2015. This monitoring initiative brings together all the custodian agencies responsible for facilitating global monitoring and reporting on SDG 6 indicators. The work is carried out through three complementary programmes that have developed indicator methodologies and data collection mechanisms. These are the:

1. World Health Organization (WHO)/United Nations Children’s Fund (UNICEF) Joint Monitoring Programme (JMP), established in 1990, tracks progress on water supply, sanitation and hygiene (WASH).
2. UN-Water Integrated Monitoring Initiative for SDG 6, known by its acronym GEMI, which was established in 2014 and supports global monitoring and reporting on wastewater,

water quality, water resources management and water-related ecosystems.

3. UN-Water Global Analysis and Assessment of Sanitation and Drinking Water (GLAAS), established in 2008, tracks finance and the enabling environment for WASH.[1]

Each SDG indicator is classified as Tier I, II or III,[2] depending on sufficient data availability at the global level to calculate the indicator according to the proposed formulation and associated methodology. SDG 6 indicators, their respective tier classification, monitoring programme and custodian agencies are set out in table 1. UN-Water produced the first SDG 6 Synthesis Report on Water and Sanitation in 2018, in addition to a series of reports that track progress towards SDG 6.

Table 1. SDG 6 targets, indicators, tier classification and custodian agencies (*As of September 2019*)

Ensure availability and sustainable management of water and sanitation for all			
Target	**Indicator**	**Tier**	**Monitoring programme/custodian agencies**
6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	6.1.1 Proportion of population using safely managed drinking water services	Tier II	JMP/WHO, UNICEF
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	6.2.1a Proportion of population using safely managed sanitation services	Tier II	JMP/WHO, UNICEF
	6.2.1b Proportion of population using a handwashing facility with soap and water available	Tier II	JMP/WHO, UNICEF
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	6.3.1 Proportion of wastewater safely treated	Tier II	GEMI/WHO, UN-Habitat
	6.3.2 Proportion of bodies of water with good ambient water quality	Tier II	GEMI/UNEP

Ensure availability and sustainable management of water and sanitation for all			
Target	**Indicator**	**Tier**	**Monitoring programme/custodian agencies**
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	6.4.1 Change in water-use efficiency over time	Tier II	GEMI/FAO
	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	Tier I	GEMI/FAO
6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	6.5.1 Degree of integrated water resources management implementation (0–100)	Tier I	GEMI/UNEP
	6.5.2 Proportion of transboundary basin area with an operational arrangement for water cooperation	Tier I	GEMI/UNECE
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1 Change in the extent of water-related ecosystems over time	Tier I	GEMI/UNEP, Ramsar
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.a.1 Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan	Tier I	GLAAS/WHO, OECD
6.b Support and strengthen the participation of local communities in improving water and sanitation management	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	Tier I	GLAAS/WHO, OECD

Sources: United Nations, 2017; and United Nations Department of Economic and Social Affairs (DESA), Statistics Division, 2019.

B. Progress towards achieving SDG 6 in the Arab region

1. Methodology

SDG 6 is comprised of six targets and nine indicators, excluding those related to the MoI. The progress achieved by 22 Arab countries is against each indicator is evaluated based on the following categories:

- The target addressed by the indicator has been reached at the country level;
- The country is on track to reach the target addressed by the indicator by 2020/2030;
- The country needs substantial efforts and improvements to achieve the target addressed by the indicator by 2020/2030;
- The indicator is not assessed in this country or it needs further analysis/clarification.

It is noted that some global reports did not include data from the State of Palestine and that indicator 6.4.1 was not included in the assessment as it remains a Tier III indicator.

The assessment was conducted through data collection, methodology review and analysis of targets and indicators. The data for each SDG 6 indicator was collected from the series of progress reports produced by UN-Water (2017/2018) and the respective custodian agencies in addition to the online data portals available for some indicators. When an indicator is incomplete due to lack of sufficient data, a subindicator was utilized instead to reflect progress towards the respective target. For example, indicator 6.3.1 (wastewater treatment) is incomplete and the annex of country data is not available, so the country data for the subindicator (domestic wastewater treatment) is used, as will be shown further in this section.

Regarding indicators 6.1.1, 6.2.1a and 6.2.1b, the WHO/UNICEF JMP produced the report *"Snapshot of Drinking Water, Sanitation and Hygiene in the Arab region: 2017 Update and SDG Baselines"* which highlights the findings and progress on WASH SDG indicators in the region. Data on these indicators were recently updated by the JMP for the year 2019 tracking the progress achieved by the region since 2017, which is discussed and analysed. The data collection stage involved also reviewing 11 Voluntary National Review (VNR) reports submitted by Arab States during 2016-2018. Some of the VNRs included values for SDG 6 indicators, mainly for indicators on WASH services and wastewater treatment.

This assessment of progress towards SDG 6 in the Arab region involved also a review of monitoring methodologies for SDG 6 global indicators as well as tier classifications. According to the updates to the tier classification following the revision of the Inter-agency and Expert Group on the Sustainable Development Goal Indicators (IAEG-SDGs), as of 4 April 2019, out of the nine SDG 6 indicators, four are Tier I indicators and five are Tier II indicators. This means that all SDG 6 indicators are conceptually clear, have internationally established methodologies and available standards. Moreover, Tier I indicators related to water stress, IWRM implementation, transboundary cooperation and water-related ecosystems have data that have been regularly produced for at least 50 per cent of countries and of the population in every region where the indicator is relevant. On the other hand, Tier II indicators related to WASH services, wastewater treatment, water quality and water-use efficiency do not have data that have been produced regularly by countries. Regarding the monitoring methodologies, UN-Water produced an integrated monitoring guide for SDG 6 which comprises step-by-step methodologies for monitoring SDG 6 indicators, including definitions, data sources and collection, computational steps and recommendations on data management.[3]

The review of the global methodologies of indicators is a critical step prior to analysing and interpreting the value of these indicators in order to assess the progress towards SDG 6 targets. In the assessment below, each indicator is interpreted in the context of the target that it addresses. Some indicators, such as ambient water quality and degree of IWRM implementation have a clear-cut value which determines if a country is on track to achieve the corresponding target or not. For other indicators, particularly indicator 6.4.1 on water-use efficiency, no specific value can be defined for achieving the respective target component "substantially increase water-use efficiency across all sectors". This is because it is a new indicator without sufficient available data and needs to be measured over time. So far, the first global baseline (2015-2018) is presented in the UN-Water and Food and Agricultural Organization of the United Nations (FAO) 2018 progress report on water-use efficiency but the indicator values cannot be compared and assessed until further values are generated in the upcoming years. Therefore, water-use efficiency is not included in figure 1 and further explanation on this indicator is provided later in this section. Other indicators, such as those related to drinking water, sanitation and wastewater treatment, have a specific value to assess if a country achieved the corresponding target/component of target (for example, 100 per cent of population using safely managed drinking water services). On the other hand, assessing if a country is on track to achieve the targets can be done by measuring those indicators. In addition, the indicator on water-related ecosystems is not explicit in the methodologies set by the custodian agencies. Hence, those indicators' values are interpreted in the context of their corresponding targets and methodologies to reflect the most accurate assessment of progress possible. Nevertheless, there are gaps in data availability for some indicators for certain Arab countries. For instance, there are 16 Arab countries that have not generated values for indicator 6.5.2 despite the high relevance of transboundary cooperation in the region. Similarly, for indicator 6.3.2 on ambient water quality, 17 Arab countries do not have data on this indicator available yet which shows that major efforts are needed to address data gaps and initiate a complete baseline for all SDG 6 indicators.

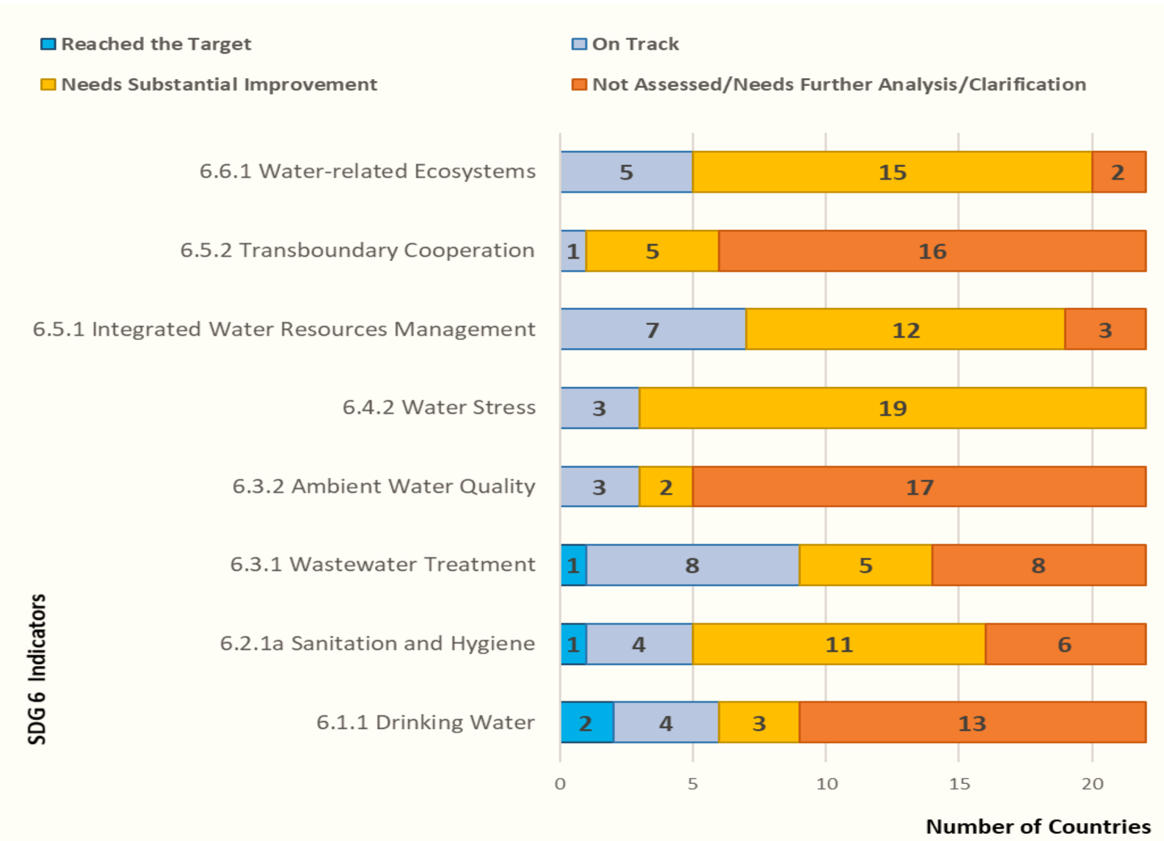
2. Assessment of SDG 6 indicators in the Arab region

Figure 1 shows the number of Arab countries that have achieved progress against each of the SDG targets according to the above methodology and classification. The data used for the SDG 6 targets and indicators for all countries are included in annex 1.

SDG indicator 6.1.1 reports on the proportion of population having access to safely managed drinking water as well as access to basic drinking water services as a subindicator. In 2015, 51 million people in the Arab region lacked basic drinking water services,[4] but this number declined to less than 48 million people in 2017.[5] All Arab countries have data on basic drinking water services reported by the WHO/UNICEF JMP, yet only seven countries had data on safely managed drinking water services available in

2015. This number increased to nine countries for 2017 according to recent updates by JMP. Out of those nine countries, two achieved universal access to safe drinking water and four countries are on track to achieve this target by 2030 as 10 per cent or less of their population remains to be covered. On the other hand, three countries need substantial improvement in order to reach universal access to safe drinking water by 2030 while thirteen Arab countries do not have available data on indicator 6.1.1 as shown in figure 1. Regarding basic drinking water services, five countries are reported to have universal access to basic drinking water services according to the latest JMP report, and this is confirmed in the VNRs of four Arab countries. Ten Arab countries are considered on track to achieve universal access to basic water services by 2030 if they maintain current efforts,[6] yet six countries need substantial improvement on the national level in order to be on track to achieve universal access to basic drinking water services. Three of those countries have a declining annual rate of change between 2015 and 2017, meaning they need to maintain substantial efforts to reach universal access to basic water services by 2030.

Figure 1. Current status of progress achieved towards implementing SDG 6 in the Arab region



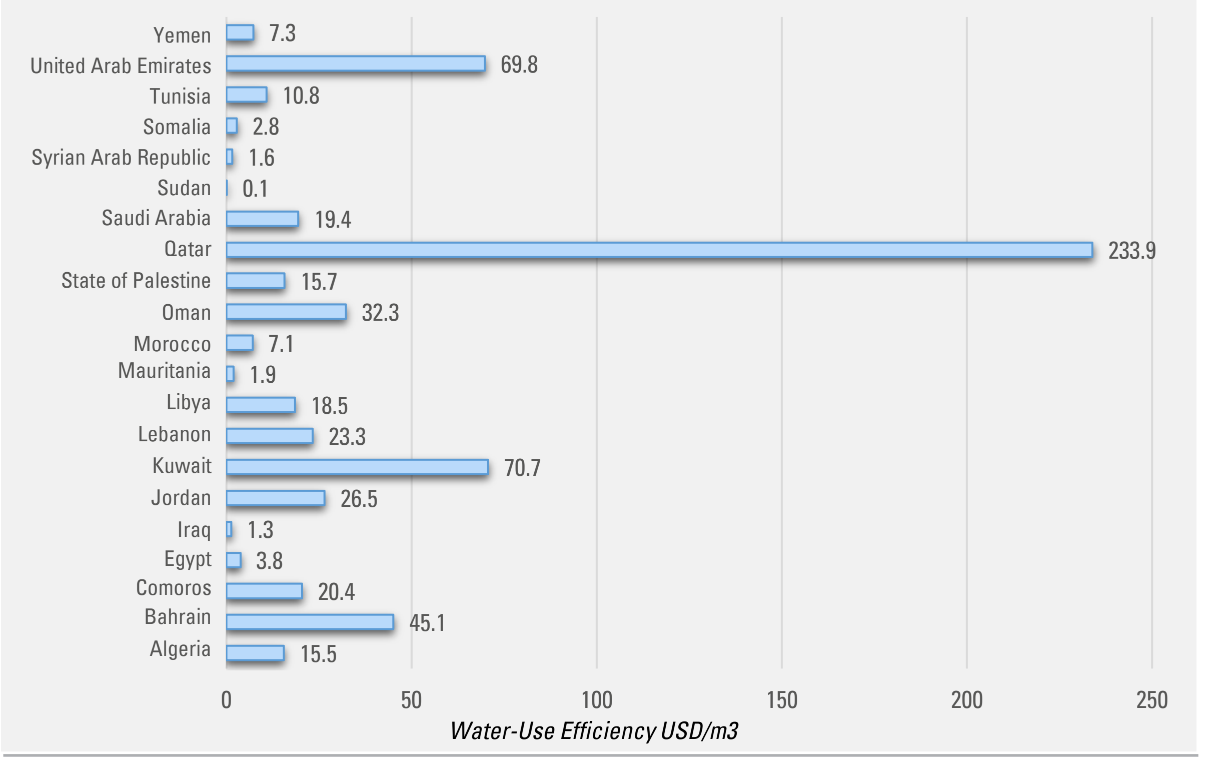
Note: Annex 1 provides the data on each indicator per country.

Similar to indicator 6.1.1, indicator 6.2.1a reports on the proportion of population using safely managed sanitation services as well as reporting on basic sanitation services as a subindicator. Only 29 per cent of the population in the Arab region had safely managed sanitation services[7] in 2015 and this increased to 39 per cent in 2017.[8] While 74 million people lacked basic sanitation services in 2015, this number declined to less than 71 million people in 2017.[9] All Arab countries have data on basic sanitation services reported by the WHO/UNICEF JMP and 16 countries have available data on safely managed sanitation services in the most recent JMP reports. Out of those 16 countries, one is reported to have achieved universal access to safely managed sanitation services and four are on track to achieve this target by 2030 if they maintain current efforts. However, 11 countries need substantial improvement in order to reach universal access to safely managed sanitation by 2030 while six Arab countries do not have data on indicator 6.2.1a available yet. Regarding basic sanitation services, seven Arab States achieved these services for nearly 100 per cent of the population according to the latest JMP report, and this is confirmed in the VNRs of three Arab countries. Eight Arab countries are considered on track to achieve universal access to basic sanitation services by 2030 if they maintain current efforts, yet seven countries need substantial improvement on the national level in order to be on track to achieve universal access to basic sanitation services.

Regarding SDG indicator 6.3.1 (wastewater treatment), data is available only for collected domestic wastewater treatment (subindicator 6.3.1a), and there are many gaps on industrial wastewater, so the indicator is not completely available.[10] One Arab country achieved the target of 100 per cent safely treated domestic wastewater as assessed by the custodian agencies (UN-Habitat and WHO). Target 6.3 explicitly specifies that by 2030, the proportion of untreated wastewater should be halved. In order to assess which countries are on track towards this target, the value of half the untreated wastewater volume is compared to the proportion of treated wastewater of the same year (2018). Eight Arab countries are considered on track to halve the proportion of untreated wastewater by 2030 while five countries need substantial improvement to achieve this target. The custodian agencies do not have this indicator available for eight Arab countries yet, so they require further data collection and assessment.

Indicator 6.3.2 (ambient water quality) is available for only five Arab countries. In those countries a total of 288 freshwater bodies comprising lakes, rivers and groundwater were assessed during different periods. The methodology followed by the custodian agency of this indicator (UNEP) showed that “a threshold value of 80 per cent compliance[11] is defined to classify water bodies as ‘good’ quality”.[12] As such, three countries have high percentages of total assessed water bodies (79-92 per cent) with good water quality and therefore are considered on track to improving water quality. The other two countries have lower percentages of the total assessed water bodies with good ambient water quality (50-67 per cent) which means more efforts are needed to improve and monitor ambient water quality in addition to further assessment of all water bodies at the country-level that have not been assessed. However, this indicator has not been yet tested in 17 Arab states, so the preliminary results do not reflect the overall regional ambient water quality.

Figure 2. Baseline of water-use efficiency (SDG indicator 6.4.1) in Arab countries



Source: UN-Water and FAO, 2018a.
Note: Indicator data are not available for Djibouti.

Indicator 6.4.1 measures the change in water-use efficiency (WUE) over time. It is defined as the dollar value added per unit of water used over a certain period of time and it is expressed in USD/m^3. This requires availability of time series data to analyse trends, but this indicator is new and has not been monitored before; as a result, the values reported on WUE cannot be compared nor assessed at this point. The rationale behind this indicator is to provide information on the economic added value generated using water in three main sectors: agriculture, industry and services. The overall water-use efficiency is calculated as the sum of the individual WUE in each sector weighted against the proportion of water used by each sector over the total water uses. Figure 2 shows the overall WUE in 21 Arab States reported by UN-Water and FAO for the baseline year 2015. The indicator is to be calculated every two years. WUE varies across the region from as low as 0.1 USD/m^3 and as high as 233.9 USD/m^3 while 12 Arab countries have WUE greater than the world average of 15 USD/m^3. However, the overall water-use efficiency does not reflect the efficiency of each sector and that should be taken into consideration while examining the different values across the region. The agriculture sector has a major impact on the low overall WUE in most of the Arab countries.

Indicator 6.4.2 (water stress) measures (in percentage) total freshwater withdrawals by all major sectors to the total renewable freshwater resources, taking into account the environmental flow requirements. FAO identifies 25 per cent as the threshold of initial water stress.[13] Three Arab countries are below this threshold indicating an absence of water scarcity, 11 countries have water stress levels surpassing 100 per cent and the rest have varying levels of water stress between 25 to 100 per cent. Most of Arab countries with water stress levels exceeding 100 per cent have largely been meeting their high water demand with seawater desalination. The world average water stress level was 12.8 per cent in 2015 which confirms that the Arab region is one of the most water-stressed regions in the world. In addition to this indicator, the water scarcity index identifies three basic thresholds for water stress: water stress for values below 1,700 m^3/person/year, scarcity for values below 1,000 m^3/person/year and absolute scarcity for values below 500m^3/person/year. This equates to as much as 86 per cent of the Arab population living in countries with a range of scarcity to absolute scarcity.[14] Target 6.4 calls for "substantially reducing the number of people suffering from water scarcity", yet this target component is not measured with a specific indicator within the global monitoring framework of the SDGs. Thus, an additional indicator is needed to measure and monitor this component given its particular importance to the water scarce Arab region.

Indicator 6.5.1 measures the degree of IWRM implementation (on a scale from 0 to 100) based on a self-assessed country questionnaire consisting of four sections: enabling environment, institutions and participation, management instruments and financing. Countries scoring between 71 and 100 are likely to reach the global target by 2030 or have already achieved it;[15] countries scoring between 51 and 70 are potentially able to reach the global target by 2030 if efforts are sustained; and countries scoring between 31 and 50 are unlikely to reach the target unless progress is significantly accelerated. Countries scoring as low as 0 to 30 are unlikely to meet the target as they have started developing elements of IWRM but have limited uptake across the country level. Nineteen out of 22 countries in the Arab region reported the degree of implementation of IWRM. Seven countries are on track in implementing IWRM, and 12 countries scored in the lowest three ranges need substantial efforts to achieve/progress towards IWRM implementation.[16] Further details on the status of IWRM implementation will be provided in chapter 2.

Indicator 6.5.2 on transboundary water cooperation has a particular importance to the Arab region which has heavy reliance on shared waters; however, only nine out of 21 countries reported on this indicator.[17] The custodian agencies for this indicator, United Nations Economic Commission for Europe (UNECE) and the United Nations Educations, Scientific and Cultural Organization (UNESCO), validated the responses of six countries and while those of the other three countries required further clarifications.[18] The indicator measures the proportion of transboundary basin area with an operational arrangement for water cooperation (in percentage) and it includes reporting on two components: a surface water component and an aquifer component that are combined to give the value of SDG indicator 6.5.2. The surface water component is not relevant for two countries that reported on this indicator as it does not apply to their national circumstances. The highest score reported is 80.5 per cent indicating that the country is on track towards achieving thorough transboundary cooperation if efforts are sustained to enhance shared water agreements. Two countries scored 13.5 per cent and 21.9 per cent, respectively, and three countries scored 0 per cent which shows that substantial efforts are needed to progress towards target 6.5. The low response rate on this indicator is, to a certain extent, due to the specificities of the Arab region regarding water scarcity as well as instability due to armed conflicts and occupation in areas with shared waters. Thus, the information obtained is very limited to allow for a comprehensive analyses of SDG indicator 6.5.2 and its progress in the Arab region.[19]

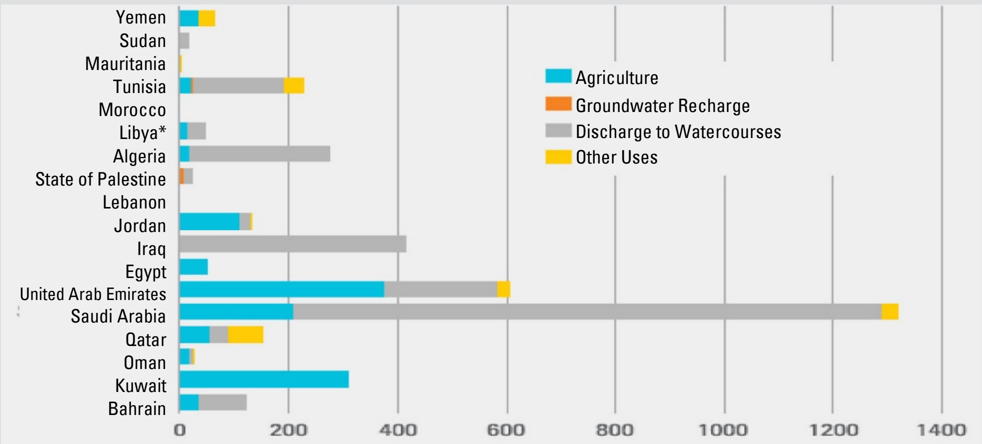
Regarding the change in the extent of water-related ecosystems over time tracked for SDG indicator 6.6.1,[20] data are available for the subindicator on spatial extent of open water bodies (lakes, rivers, estuaries and artificial water bodies, such as reservoirs). Spatial extent is one of the four subindicators under indicator 6.6.1 and open water bodies are one type of five water-related ecosystems under this indicator. This subindicator is generated using satellite-based earth observation data. The baseline reference used in the methodology is 2001-2005 and data time series is available from 2001 to 2015. Data are requested every five years, with the latest period assessed 2011-2015. The deadline for achieving the target is 2020. This subindicator measures gain or loss in the size or area of an open water body. Five Arab countries reported a gain in the spatial extent of open water bodies, and thereby are considered on track towards increasing the spatial extent of open water bodies unless there was a loss in natural water bodies which has not yet been specified at this stage of reporting. Fifteen countries have a loss in spatial extent of open water bodies which requires substantial improvements to restore water-related ecosystems. The subindicator is not available for two Arab countries. It is important to take into consideration that some countries have more loss or gain than others, and the interpretations vary from one national context to another. For instance, an increase in spatial extent of open water bodies could result from the construction of dams and reservoirs. One of the limitations of the applied methodology for this subindicator is that the data set obtained in 2017 on the spatial extent of open water bodies, combines data on natural and artificial water bodies which is potentially misleading. Many countries are experiencing a loss of natural water-related ecosystems and a gain in artificial water bodies. As such, the new global data set on spatial extent will separate data on artificial and natural water bodies.[21]

The above assessment shows that for each indicator, fewer than 50 per cent of the Arab countries have achieved or are on track to achieve SDG 6 targets by 2030. More than 50 per cent of the countries in the region needs substantial improvements and more efforts in order to be able to achieve the majority of SDG 6 targets, namely those related to WASH services, water stress, IWRM and water-related ecosystems. Nonetheless, there are data gaps in all of the indicators; especially for indicators 6.3.2 and 6.5.2, which are not available for more than 50 per cent of Arab countries. Therefore, the assessment of progress on SDG 6 indicators in the Arab region will become more comprehensive only with the increase of data availability in the upcoming reporting cycles. Moreover, some indicators or data on subindicators that could be available on the national levels have not been acquired and disseminated. This can be resolved by enhancing the communication between national focal points and custodian agencies. Similar indicators/subindicators are also available on the country level for monitoring national strategies and vary from one country to another. Nonetheless, some target components are not addressed by the set indicators, so additional indicators are suggested in box 1 for the implementation of national strategies.

Box 1. Example of proposed additional water-related indicators for consideration by the Arab countries

Proposed indicator 1: SDG 6.1.2 "Affordability of water resources" – This suggested indicator is important to ensure that expenditures on water purchase do not inhibit access to water and sanitation services or prevent people from meeting other basic needs. It can further inform policymakers with regards to cost recovery through the assessment of appropriate tariff structures. The JMP is currently collaborating with the World Bank on global monitoring of water, sanitation and hygiene (WASH) expenditures. The most used approach currently relies on the definition of affordability as the amount spent on water purchase as a percentage of the total household expenditures.

Proposed indicator 2: SDG 6.3.3 "Safely Treated Wastewater Reuse" – This would measure the water reused as a percentage of safely treated wastewater at the national level. This indicator could provide insights on the scope of countries' efforts and progress in incorporating treated wastewater as part of their national water development plans and policies. It is worth mentioning that wastewater reuse in the Arab region does not exceed 24 per cent of the safely treated wastewater and is mainly used in the agricultural sector. About two thirds of safely treated wastewater is discharged to surface water bodies. This shows that there is a great potential for expanding the applicability of wastewater reuse in the Arab countries to offset water shortages constraints. As part of the MDG+ Initiative, data on wastewater reuse were generated for 18 Arab countries specifying the amount reused according to the types of uses as shown in the figure below.



Sources: LAS, ESCWA and ACWUA, 2016.

Proposed indicator 2: SDG 6.4.3 "Percentage of people suffering from water scarcity" – While the wording describing the overall target includes "reduce the number of people suffering from water scarcity"; the global indicator framework does not clearly mention the number of people affected by water scarcity and hence there is currently no universally agreed methodology to calculate this indicator. Given the importance of this indicator to the water scarce Arab region, ESCWA has been involved in regional and global discussions with regards to the conceptualization of the additional indicator and the development of a methodological framework for its implementation.

Sources: For SDG 6.1.2. and SDG 6.3.3 deliberations during Expert Consultation on SDG 6 Indicators (Beirut, December 2016); for SDG 6.4.3, LAS and FAO, 2018, *unpublished*.

C. SDG interlinkages

> *"The interlinkages and integrated nature of the Sustainable Development Goals are of crucial importance in ensuring that the purpose of the new Agenda is realized."*
>
> *Preamble of the 2030 Agenda for Sustainable Development, 2015.*

The integrated and interlinked nature of the SDGs is critical to the 2030 Agenda. Interlinkages across the SDGs foster a coordinated and integrated approach to the 2030 Agenda which can make implementing and monitoring SDG-related national development plans more cost-effective. This will help to maximize synergies and minimize trade-offs between a specific SDG and other goals. It also ensures coherence and appropriate synchronization of institutional and policy reforms and public investments so that limited resources are used more efficiently and sustainably.

There are different methods to examine the SDG interlinkages which can be divided between quantitative and qualitative approaches. The first approach examines SDG interlinkages through a pure statistical and analytical lens, while the second examines the sectoral links across the different themes of the SDGs. Both approaches ultimately aim to define priorities and needs for policymaking, yet for the purpose of this report, the focus is on the qualitative interlinkages between the water-related SDG 6 and other SDG targets or relative sectors.

An example of the quantitative analysis of the SDG's interlinkages is the "iSDG" simulation model. Developed by the Millennium Institute, the iSDG model constitutes 30 sectors divided under the three pillars of sustainable development (economy, society and environment) covering all 17 SDGs. The model is customized and calibrated with country data and refined to address national realities and priorities.[22] It allows for evaluation of the likely benefits of proposed policies and strategies and the undesired long-term impacts according to scenarios up to 2050. The model provides quantitative values for anticipated progress towards achieving the SDGs by 2030 under "business as usual" conditions and for anticipated progress towards achieving the SDGs by 2030 in accordance with the user's defined policy interventions. Australia is one of the counties that has utilized the iSDG model based on their national priorities as explained in box 2.

A qualitative analysis of the SDGs interlinkages was conducted by the UN-Water in the *Water and Sanitation Interlinkages Across the 2030 Agenda for Sustainable Development* (2016) report by analysing how SDG 6 and its targets interlink with the other goals and their corresponding targets. The links are categorized into two types: main synergies and potential conflict. The first refers to links that are mainly positive, in a way that they may be mutually reinforcing or have positive interdependencies, and the second refers to links that may still have positive aspects, but along with a potential conflict, in one or both directions, unless policies and plans for implementation deliberately address the constraints and trade-offs. The links are discussed under the three dimensions of sustainable development as follows:

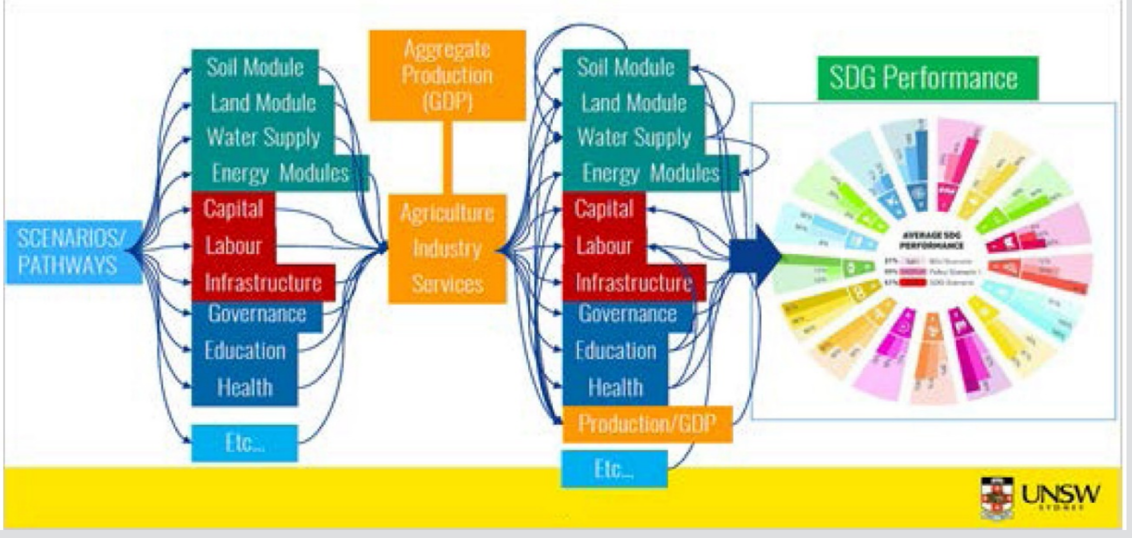
- The social dimension comprises the links of SDG 6 to goals 1 (poverty), 2 (food), 3 (health), 4 (education), 5 (gender), 7 (energy), 8 (work), 10 (inequality), 11 (cities and communities) and 16 (peace and security);

- The economic dimension comprises the links of SDG 6 to goals 8 (work and economic growth), 9 (infrastructure and industry), 7 (energy) and 12 (consumption and production), in addition to goals 2, 10 and 11;
- The environmental dimension comprises the links of SDG 6 to goals 13 (climate), 14 (oceans) and 15 (terrestrial ecosystems), in addition to goals 2, 7, 8, 11 and 12.

Box 2. Australia's experience with the SDGs

The Australian experience with the 2030 Agenda for Sustainable Development suggests that countries must focus their national implementation efforts of SDGs on priority targets and indicators, given their broad and composite scope. The Australian National Sustainable Development Council and expert advisers (known as Goal Leads) reviewed all SDGs targets and indicators and selected 86 priority SDG targets and 144 indicators that are most relevant to and important for sustainable development in Australia. Clear targets are important for assessing and benchmarking Australia's progress on the SDGs, yet in many cases, the SDG targets are generic and do not include specific numerical target values. In addition, the lack of target values specific for Australia is a significant gap. Hence, the selection process was preceded by an SDG baseline assessment where the National Sustainable Development Council identified an existing target (national or international) value or proposed a target value based on expert analysis. The assessment methodology included a reference year (2000) and baseline year (2015) to generate trend direction of Australia's progress towards certain SDG targets. The outcome of the assessment showed that the top two goals that are on track in Australia are SDG 3 (good health and well-being) and SDG 4 (quality education), whilst the bottom two goals are SDG 10 (reduced inequalities) and SDG 13 (climate action).

After carrying out the baseline assessment and setting out the targets, the next steps for Australia include: assessing interlinkages and feedback–systems modelling; policy design and evaluation–scenario/pathways modelling; and strategy or roadmap formulation. Given the indivisible nature of the SDGs and complex interlinkages, assessing those interlinkages correspondingly with their indicators is a significant and prerequisite step to guide policymaking and strategy formulation. In this context, research efforts have been developing the iSDG Simulation Model which included 78 SDG indicators and other national indicators in Australia with an integrated macroeconomic model covering 30 sectors across the three dimensions of sustainable development. the model explores different policy pathways and scenarios and analyses their impact on SDG performance.



Sources: Millennium Institute, n.d.; Allen (2018).

SDG interlinkages are relevant to all countries but must be adapted to the national level where governments can identify and assess those interlinkages (annex 2). In this way trade-offs and benefits can be determined that will, in turn, guide governments in setting and implementing priority policies and sectoral strategies to maximize benefits. For example, SDG target 2.3 which calls for doubling agricultural productivity by 2030 would be incorporated in policies of the agriculture sector for pursuing food security, a critical effort for the Arab region. However, increasing the agricultural productivity could imply more water resources would be needed, especially given that the region already utilizes 80 per cent of the freshwater resources in the agriculture sector, which is also the least water-use-efficient sector regionally. This would conflict with target 6.4 on substantially increasing water-use efficiency in all sectors unless agriculture productivity is increased through, for instance, adopting efficient irrigation technologies and practices. This could also require more land for crops, impacting targets 6.6 on protecting water-related ecosystems. Another example comes from the GCC countries where in order to meet the SDG 6.1 on providing safely managed drinking water, limited renewable freshwater resources requires the reliance on desalination. Yet, desalination has impacts on the marine environment (SDG 14) and climate action due to the use of fossil fuel and energy-intensive processes (SDG 13). These interlinkages need to be addressed through policy measures (such as demand management to reduce emissions) and also through technological advancements (such as solar energy and offshore brine disposal) to reduce the impact on the marine and air quality. To that end, the interlinkages are complex and should be critically assessed according to national priorities and capacities in order to optimize the best scenario among different alternatives and trade-offs.

D. Water-related SDGs

The water sector is central to national development and sectoral planning and, as such, SDG 6 plays a particular role in advancing sustainable development. Water is a cross-cutting issue that affects the achievement of nearly all the 17 SDGs which are explicitly or implicitly linked to SDG 6 to varying degrees.[23] Figure 3 illustrates how SDG 6 is central to all SDGs and how water-related issues are intrinsically substantive in addressing other issues of sustainable development in the Arab region. The following section will further discuss some of the water-related SDGs and their interlinkages within the regional context along with national case studies.

1. Integrated water resources management

IWRM can address the synergies and potential conflicts between the targets within Goal 6. It does this by balancing the demands from various sectors on water resources, as well as the potential impacts of different targets on each other, to form a coordinated planning and management framework. This is achieved by considering all levels of management, including transboundary cooperation and upstream-downstream uses as appropriate. IWRM addresses the balancing of the needs of different sectors and stakeholders. Thus, multi-stakeholder partnerships (SDG 17) are a logical component of IWRM which seeks mutual planning, management and problem-solving to realize the optimal common solutions for different stakeholders. IWRM requires coordinated management of water, land and vital ecosystems (SDGs 14 and 15) to maximize social and economic benefits (SDG 8), which ultimately enhances good water governance (SDG 16). There is no universal approach to implementing IWRM, and each country must develop its own pathway based on political, social, environmental and economic circumstances. In this context however, SDG indicator 6.5.1 allows the measuring of the degree of IWRM implementation on the country level as discussed earlier in this chapter, and thereby provides insights on regional and global implementation.

Figure 3. SDG 6 is central for sustainable development in the Arab region

Sources: WHO and UNICEF, 2018; ESCWA, 2015; ESCWA, 2016; ESCWA, 2017a; ESCWA, 2018b; ESCWA and FAO, 2017; UN-Water, 2016b; ESCWA and BGR, 2013; WHO, 2016.
Note: Adapted from UN Synthesis Report on Water and Sanitation 2018, figure 21, p. 130 into the context of the Arab region.

In addition, the human health dimension should be considered as a key element in the implementation of IWRM. For instance, among water-borne diseases infectious diarrhoea, where infection is spread through drinking water or contaminated food or from person to person as a result of poor hygiene, is a key concern. In addition, severe diarrhoea leads to fluid loss and may be life-threatening, particularly in young children and people who are malnourished or have impaired immunity.[24]

2. Ecosystem-based management supporting IWRM

Furthermore, the implementation of IWRM principles can be complemented by an ecosystem-based management (EBM) approach. EBM provides a framework for the management of environmental public goods through the integration of land, water and natural resources targets towards their conservation and sustainable use in an equitable way. The two approaches, IWRM and EBM, are addressed in SDG targets 6.5, 6.6, 14.1, 14.2 and 15.1 which emphasize the interlinkages between water management issues and water-related ecosystems protection. Pursuing an integrated approach for the management of water from an ecosystem-based management approach can support the integration of the sectorial goals under integrated approach for water management as shown in table 2 on the commonalities between the two approaches. Furthermore, financial resources generated from charges imposed on the use of ecosystems services can provide necessary funds for the implementation of IWRM.

Table 2. Commonalities between IWRM and ecosystem-based management

Ecosystem preservation measures	Water resources management gains	Synergies across sectors
Water harvesting	Groundwater recharge Water supply regulation Water quality regulation	Climate change adaptation Increased food security Protection and valuation of traditional knowledge
Wetlands restoration/ conservation and constructed wetlands	Restored ecosystem for service provision Water purification and biological control Water temperature control	Healthy ecosystems Carbon sequestration Biodiversity benefits Climate regulation Recreational benefits
Reforestation and forest conservation	Water supply regulation Water purification and biological control	Healthy ecosystems Carbon sequestration Air quality improvement Climate regulation Soil conservation Recreational and aesthetic value

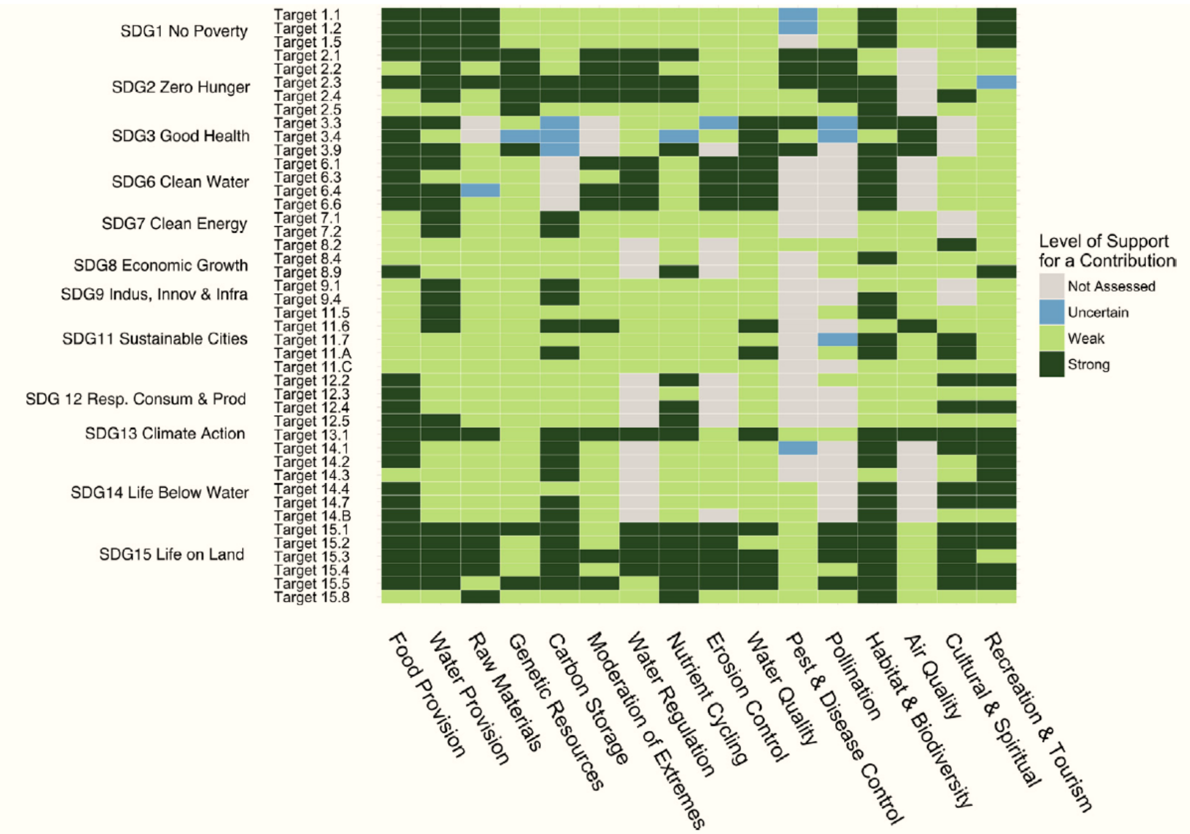
Source: Adapted from Bernex, 2016.

3. Ecosystem-based approaches applied in the Arab region

The ecosystem-based management (EBM) is centred on a strategy that builds on scientific tools and methodologies for the integrated monitoring, assessment and analysis of the various functions and processes of the ecosystem. A better understanding of the physical, chemical and biotic aspects related to the ecosystem constituents and their interactions is crucial to guide efficient management strategies and policies supporting sustainable and equitable use of water-related ecosystems. Nevertheless, ecosystem services can contribute to the achievement of various targets across the sustainable development goals. Figure 4 depicts the perceived role of various ecosystem services in contributing to the SDG targets.

The sustainability of ecosystem services which includes regulation (climate, water, flood protection, and pest and disease control), provisioning (natural resources for consumptive and non-consumptive uses) and cultural functions (recreation, tourism, etc.) are strongly linked to the status of available water resources. Similarly, ensuring a healthy ecosystem can support water quantity and quality and in turn influences the efficiency of the ecosystem service delivery.

Figure 4. Contribution of ecosystem-services to SDG targets



Source: Wood and others, 2018.

In the context of sustainable water and land resources management, *hima* practices have been revived in the Arab region for ecosystem preservation. *Hima* means protected area in Arabic, and it relies on setting land aside to allow for the natural regeneration of the local ecosystem. It is considered the oldest known form of organized land conservation approach in the Arab region as it goes back to more than a thousand years. It is a form of communal land management, consensually administered with well-established hierarchal governance systems. It aims to provide a successful model for the integration of the sustainable use of ecosystem services with developmental activities.[25]

Nevertheless, changes in societal structures and the ensuing weakening of the tribal system accompanied with land use changes has resulted in the phase out of *hima* management schemes. Recently, faced with the constraints of increasing aridity and water scarcity, some parts of the Arab region are reviving the traditional *hima* practice. The traditional system is in line with the key concepts of EBM in that it relies on a community-based approach for the management of shared natural resources, considers the natural ecosystem as a single unit, and engages community members in continuous dialogue to build consensus on how best to manage the scarce natural resources. This community-based approach addresses the social dimension of the 2030 Agenda that advocates a multi-stakeholder and inclusive approach to achieve sustainable development. Thereby, *hima* practices can also be linked to implementing target 10.2 which states “By 2030, empower and promote the social, economic and political inclusion of all”.

In this regard, the International Union for the Conservation of Nature (IUCN) in collaboration with the Ministry of Agriculture in Jordan have successfully implemented the *hima* approach in four communities located in the Zarqa River basin faced with land degradation and the overexploitation of groundwater resources.[26] Similar natural resources conservation and restoration through *hima* practices were achieved in Saudi Arabia as part of the national protected areas management programme.[27] These practices have proved considerably successful in alleviating erosion resulting from overgrazing. Consequently, many Arab countries have recognized the benefits of preserving natural resources in their national development plans and strategies. The National Rangeland Strategy of Jordan (2014) incorporated the *hima* approach as an effective mean to address governance of national rangelands. Morocco has similarly acknowledged the role of protection, restoration and maintenance of ecosystems to combat the impacts of climate change in its Nationally Determined Contributions (NDCs).

The above examples thus show how SDG interlinkages (SDG 6, 10, 13, 14 and 15) are put into practice through national policies and strategies for ecosystem preservation and restoration in the Arab region. Although few Arab countries reported under indicator 6.6.1 (water-related ecosystems), many actions have already been contributing to the achievement of target 6.6 and goals 14 and 15 that can be linked to water-related SDGs on the national and local levels and need to be considered by the countries in the region.

4. Water-energy-food nexus, partnerships and technologies

Particular synergies and trade-offs between water, energy and food can be better understood through the examination of interlinkages between targets and indicators set under the 2030 agenda for sustainable development (SDGs 2, 6 and 7). Access to clean and affordable energy (SDG 7.1) is a key enabler for food security (SDG 2.1 and 2.2) since ensuring clean and affordable energy resources will lessen the dependency of food production on fluctuations in fossil fuel market prices.

Most production processes for the various types of energy generated are water intensive and energy is needed for the extraction, conveyance, distribution and treatment of water resources. The interlinkage is highly relevant to countries of the Arab region where water development is, to a large extent, met by energy-intensive technologies such as desalination and wastewater treatment techniques. More than half of the world's desalination capacity is installed in the Arab region. Similarly, GCC countries rely heavily on treated wastewater for their overall water supply since treated wastewater volumes exceed renewable freshwater endowments in the United Arab Emirates, Qatar, Kuwait and Bahrain.[28]

The interlinked nature of the water, energy and food sectors is further substantiated by the impacts investments performed in one sector can have on the performance of the other. Engaging the private sector in water projects has always been a problematic issue, since water services are highly subsidized, hindering effective cost recovery and discouraging private sector investments in water services provision. In contrast, the energy sector which is characterized by higher levels of productivity has been more successful in engaging the private sector. Developments achieved under public-private arrangements in the energy sector have had positive impacts in the water sector. These public-private partnerships between the water and energy sectors provide an aspect of the linkages to SDG 17 on partnerships as a mean of implementation. Moreover, many water-deprived countries in the Arab region are increasingly considering the interlinkages between the water and energy sectors when identifying the water development technologies from the pool of available possible options. This reflects further interlinkages with SDG 9 related to innovation and infrastructure. The case study in box 3 shows a practical example of these interlinkages with respect to ecosystems.

Box 3. Management of water-related ecosystems in Iraq

A successful experience from the Arab region for the implementation of comprehensive frameworks for the management of water-related ecosystems is the case of the Iraqi marshlands. A two-year project (2014-2016) was initiated by the United Nations Environment Programme Regional Office for West Asia to use the World Heritage Inscription Process as a tool to enhance the cultural and natural resources management of the Iraqi Marshlands. The ultimate aim was to promote longer-term sustainable management practices of the Iraqi Marshlands that reflect the unique historical, cultural, environmental, hydrological and socioeconomic characteristics of the area. The inscription process was used to enhance the natural and cultural resources and strengthen institutional and technical capacity of local communities to manage the marshlands, conserve their biodiversity and sustain their ecosystem services of food, water and fibre, as well as build the resilience to climate change. A consolidated management plan was finalized in June 2015. The project incorporated a consultative process as well to reconcile the conflicts in interest among the various stakeholders involved.

Source: ESCWA and UNEP, 2017.

Water-use efficiency in the agriculture sector (indicator 6.4.1) is intrinsically linked to resilient and productive agricultural practices (indicator 2.4.1). Balancing water conservation objectives (SDG 6) with increasing demand for food production (SDG 2) has been at the forefront of the policymakers' attention. There is an increasing recognition of the need to optimize the use of water in the agricultural sector. With this in mind, technological advancements and tools have been deployed to optimize the allocation of limited resources in the production process. A technological approach which combines water harvesting practices with groundwater recharge in arid and semi-arid regions[29] has long been practiced in the Arab region. Water harvesting and recharge can offset inconsistent patterns of water availability resulting from precipitation with great spatial and temporal variability. Furthermore, pilot projects from the region have demonstrated the capability and feasibility of managed aquifer recharge (MAR) systems to treat collected water for subsequent use in irrigation. It is widely acknowledged among water professionals in the region that the potentials of MAR techniques are not fully exploited. Further research and development are still needed for a better understanding of the scope of their application to the Arab region and optimize the economic feasibility of the processes.

5. Economic aspects of water supply and sanitation services

Findings from SDG 6.1 monitoring under the WHO/UNICEF Joint Monitoring Programme (JMP), have highlighted the Northern Africa and Western Asia region, which includes 19 Arab countries, as the region with the second highest rates of water expenditure. It was found that a little less than 20 per cent of the population spent more than 2 to 3 per cent of their household expenditures on WASH services. This is twice the global expenditure rates of total household expenditures on WASH services.[30] The poor and disadvantaged, who are most often not connected to water supply and sanitation networks, end up paying much more for the water-related services than their connected counterparts.

A key step to enhance affordability of water in the Arab region is through the improvement of efficiency in water services delivery. Nevertheless, even with most optimal levels of service delivery, the role of subsidies will remain central to advancing progress towards a universal water services coverage in the region. That is, heavily subsidized water, in the majority of Arab countries result in water costs that do not reflect their true value. Water is typically priced at around 35 per cent of the production costs.[31] In the case of desalination, the cost coverage is even lower and does not exceed 10 per cent of the production costs. This is further compounded by subsidized energy tariffs which encourage energy-intensive water extraction activities further increase pressure on limited water resources. Furthermore, subsidies are often focused on capital investments which benefit mostly communities that are already connected to distribution networks and hence further exacerbate existing inequalities.[32] Therefore, in implementing subsidy policies, the financial sustainability of services provided as well as the associated environmental and social implications should be carefully considered. Public-private sector partnerships have been touted as a means for providing needed water resources for sustainable development, which can benefit from private sector investment that can draw in new technologies and innovation, such as demonstrated in Morocco (box 4).

Box 4. Morocco's largest concentrated solar power desalination plant based on a public-private partnership model

The construction of what is expected to be world's largest seawater desalination project was initiated in July 2018 in Morocco as a public-private partnership (PPP) megaproject. The Chtouka-Aït Baha seawater desalination plant is designed for a production capacity of 275,000 m^3 desalted water per day and will be operated by what is expected to become, upon completion, the largest concentrated solar power (CSP) complex in the world: the Noor complex. The PPP involves the National Office of Electricity and Drinking Water (ONEE) and BMCE Bank of Africa along with the Spanish company Abengoa. The feedwater will be extracted from the sea in the region of Tiznit, pretreated and then pumped to the Reverse Osmosis (RO) desalination plant. The project consists of a drinking component and another destined for the generation of water for irrigation for an estimated investment of 3.8 billion dirhams (more than 345 million euros). The water generated from the desalination plant would irrigate the Chtouka region which characterized by high agricultural productivity of cash crops, contributing substantively to the country's export revenues.

The technical aspects of the project implementation were consolidated by an agreement between the government and the local farmers to limit the pumping of the degrading groundwater resources through the establishment of a quota system for groundwater withdrawals. The aim is not limited to safeguarding the declining groundwater resources but contributes as well to groundwater recharge through agriculture return flows. In addition, the water generated will contribute to ensure drinking water supply of the Grand Agadir region.

Source: Hirich and others, 2016.

Considering the trade-off between cost recovery for the service provider and affordability concerns for the low-income households is at the centre of achieving economic efficiency for water services delivered. Nevertheless, financial instruments, notably tariff structures, when designed and applied conveniently can support water conservation at the household level.[33] Setting and implementing water tariffs in the Arab region which support cost recovery of water services has stirred opposition and disagreement in the past. Some attempts have been made recently to adjust the current tariff rates to levels that better reflect cost of the service while preserving the human right to water access. For instance, Tunisia is attempting a new tariff scheme which balances short-term social and financial objectives with longer-term economic ones.[34] The tariff scheme applied incorporates as well longer-term goals for the sustainable management of water resources through adequate resource allocation among the various sectors as well water rationalization considerations. The approach for setting the tariff is based on "increasing block tariff" scheme that sets rates as low as 21 per cent of the average cost of service for the first block and increases along 7 blocks to reach 146 per cent recovery rates for the highest consuming segment.[35]

6. Social value of water

The social aspects of the water tariff must be taken into consideration to ensure the right to water for the poor while balancing the financial viability of water service providers. Most commonly applied water valuation approaches are based on market-related considerations focusing on cost recovery for infrastructure, production and distribution, efficiency, growth and profits and therefore, underestimate the still poorly understood environmental and social value of water to the community.

Assessment of social value of water incorporates the perceptions of water value to the community and hence is particularly challenging. Approaches to quantify water's social value are based on assessments of the relative importance that people place on returns from marginal water use on the quality of their livelihoods. Some aspects of this value, but not all, are captured in market prices. Consequently, there is a lack of a universal methodological framework for the assessment of the social value of water.[36]

Improving access of water within a community is particularly beneficial to women. Women are typically the primary caretakers within the family and society and thus are the ones responsible for securing adequate water supplies for drinking, food preparation, health and sanitation purposes as well as for washing and cleaning. Gender roles influence how men and women respond to inequalities and differences in water resources accessibility. Therefore, progress on achieving SDG 6 targets in terms of improved water accessibility, availability, affordability as well as improved access to sanitation services means more time available for women to spend in paid activities, improved dignity and improved personnel and family health. Furthermore, a large share of women work force is active in the agricultural sector mainly in low-income and lower-middle-income Arab countries[37] and hence better water accessibility will support progress in achieving SDG 2 (food security), SDG 5 (gender equality), SDG 8 (economic growth) and SDG 10 (reduced inequalities).

Despite their heavy reliance on water in their daily activities, women's control over natural resources such as land and water remain constrained by long-standing social and cultural norms and values. Nevertheless, experience has shown that women's involvement in water-related development projects can enhance effectiveness and efficiency of outcomes. The importance of involving women in water-related project design and implementation was clearly demonstrated in grey water treatment projects implemented in Jordan, State of Palestine, Lebanon and Yemen[38] that have resulted in improved food security (SDG 6.2) and water availability for use at the household level (SDG 6.5.1) as well as reduced contamination from sceptic tanks (SDG 6.5.2).[39] Other examples from Yemen, for example, demonstrate the important role of women in mediation and conflict resolution concerning the allocation and use of disputed shared water resources within the community.[40]

Emerging Water Priorities in the Arab Region

2. Emerging Water Priorities in the Arab Region

Given the complex water interlinkages that were shown in the previous chapter, water security is the key emerging challenge facing Arab countries in meeting their future water demands as well as in achieving sustainable development. The main stressors affecting water security in the region are water scarcity, shared water resources and climate change. SDG target 6.4 addresses water scarcity in a global context, yet water scarcity conditions vary within regional and national contexts and thus should be addressed according to national needs and social, cultural, economic and environmental considerations. The issue of water scarcity has been exacerbated by low water efficiencies (for example, losses in water supply, losses in water use, lack of recycling and reuse) and the continuous degradation of available water resources. Other factors are competing water uses among the different economic sectors at the national level in addition to the conflicts arising from the management of shared waters between Arab countries and other countries from outside the region. Climate change is a major emerging stressor to achieving water security as RICCAR projections have shown increased warming conditions and reduced precipitation levels towards the end of the century in most areas of the Arab region.

This chapter discusses the major challenges in relation to water security; including drinking water and sanitation, water availability, IWRM implementation, shared water, governance, climate change and gender. At the end of the chapter, an overview is provided on a conceptual framework for water security in the Arab region that considers a human rights-based approach within the context of the 2030 Agenda for sustainable development.

A. Safe drinking water and access to sanitation

Access to basic drinking water and sanitation services in the Arab region has increased from 80 per cent and 75 per cent in 2000 to 87 per cent and 81 per cent in 2015 respectively.[41] Even with this important stride forward over 51 million people in the Arab region still lack access to basic drinking water services and over 74 million people do not have access to basic sanitation services.[42] Also, there are no regional estimates yet for the proportions of population using safely managed drinking water and sanitation services (SDG indicators 6.1.1 and 6.2.1a) as only seven Arab countries have reported on the first indicator and 15 Arab countries have reported on safely managed sanitation services. This reflects the disparity between Arab countries in the progress towards achieving access to safe drinking water and sanitation for all. For instance, almost all Gulf Cooperation Council (GCC) countries have reached full coverage of safely managed drinking water services, whereas basic water services are decreasing in Comoros, Jordan and the State of Palestine.[43] Data reported on sanitation services show a greater disparity between Arab countries, even across the middle-income countries where the proportion of population with access to safe sanitation was the lowest at 19 per cent and 20 per cent in Algeria and Lebanon respectively, and the highest at 73 per cent and 77 per cent in Tunisia and Jordan respectively in 2015.[44]

The inequality of access to water and sanitation services is also persistent between rural and urban areas. As for basic drinking water, 23 per cent of the population in rural areas still lack basic drinking water service compared to only 6 per cent in urban areas. Additionally, 32 per cent or 51 million in rural areas lack basic sanitation services compared to 10 per cent or 22 million in urban areas. Many Arab countries have populations suffering from intermittent water supply which is not reflected in the proportion of population having access to basic water services: nearly 24 per cent of the regional population live without water available when needed.[45] Armed conflict and occupation are other major issues exacerbating insufficient access to water and sanitation services in the Arab region. As the water infrastructure has been attacked in Yemen, in 2017 14.5 million people were reported to lack access to clean water, sanitation and hygiene services,[46] which is directly associated with the cholera outbreaks that led to the death of 2,310 people between April 2017 and July 2018.[47] The Israeli occupation in the State of Palestine has been aggravating the water situation, specifically in Gaza where 1.2 million people (approximately 67 per cent of Gaza's population) have lacked access to water since the war in 2014. Also, despite the fact that 91 per cent of the population is connected to public piped water networks, the average water consumption in Gaza and the West Bank is around 78 litres per capita per day which is below the recommendation of the WHO of 100 litres per capita per day.[48]

B. Water and gender

In most communities, women have primary roles in management of water supply and sanitation, yet these are often overlooked when formulating water sector policies and strategies on national and local levels. Similarly, in many countries in the region, women and men are not equally represented in the processes of water resources management. The gender challenges in the water sector are associated with gender inequality in employment, gender disadvantage in irrigation management due to land ownership restrictions for women[49] as well as inadequate access to safe drinking water and sanitation which has disproportionate effect on women and girls as they are primarily responsible for water provision on the household level.[50] Moreover, conflicts and wars aggravate the hardships that women are already exposed to, especially in water-scarce conditions. For example, in Iraq, thousands of women were forcibly displaced to temporary camps and shelters due to continual terror attacks.[51] Displaced women are usually responsible for providing water and food in the camps, whereby they are forced to cross long distances to fetch water which is often not sufficient to meet the basic needs of their families. Displaced women and girls are also vulnerable to violence and humiliation as they are sometimes forced to share the same sanitation facilities with the displaced men.[52] Despite women and being the main users and provisioners of water, they are often excluded from decision-making processes for water management.

Although there is strong international support to address gender issues in the water sector, the gaps in gender-disaggregated data continue to hinder the progress towards mainstreaming gender concerns in water agendas and policies. Gender-disaggregated water data vary across different themes including, but not limited to, women's access to water and sanitation facilities; women's employment and roles in the public water sector; and women's role in access to water resources for irrigation.[53] Gender-disaggregated data also vary due to different sources, data collection procedures, survey methods and the levels of studies carried by different institutions. For example, there are global institutions such as United Nations Department of Economic and Social Affairs (DESA), FAO, UN-Women, UN-Habitat and the World Bank that have developed indicators and collected data on global and regional levels. There are also some national non-governmental organizations (NGOs) that have initiatives to collect gender-disaggregated water data at the national level.[54] However, the lack of accurate and reliable gender-disaggregated water data means it will remain difficult to overcome the gender issues in the water sector and more difficult in the water-scarce Arab region.

C. Water availability and current uses and water balance

Most Arab countries suffer from prolonged imbalance and a significant gap between available water supply and rising water demand. This imbalance is expected to be further aggravated in the future as a result of increased population growth, conflicts and forced displacement, the need for rapid economic development and the projected impacts of climate change. A study on future water in the Middle East and North Africa (MENA) region projected the water demand gap for the period 2020-2030 to grow about twofold, from 119 mcm per annum to 199 mcm per annum by 2050.[55] Water demand management and augmenting water supply through non-conventional water resources such as desalination, treated wastewater in addition to maximizing the recharge of groundwater in deep aquifers, can partly fill this gap.[56] Quantification of these management measures and options is necessary as well as making available sufficient storage capacities through the building of small dams and exploring potential storages in medium and deep groundwater aquifers that have been overexploited by users. However, stringent regulations through laws and legal frameworks need to be pursued to ensure high water quality standards and protection of fossil water storage from pollution. The next chapter will examine the water resources gap in the Arab region and the current status of specific water resources measures, conditions and indicators for detecting trends and projecting future scenarios on water balance and availability in more depth.

Country-specific characteristics of water availability and uses as well as challenges facing water resources management have been extensively reported in national water resources strategies and plans by the Arab countries. For instance, the water sector in Jordan is characterized by severe water scarcity and increasing demand due to high population growth, the hosting of several influxes of refugees and economic development needs. Jordan's annual renewable resources of less than 100 m^3/capita are far below the global threshold of severe water scarcity of 500 m^3/capita.[57] National water resources and water balance are facing negative impacts due to higher demand by increased population and displaced people, overexploitation of groundwater resources and the expected shortage due to the impacts of climate change on future availability of water supply. The key challenges facing the water resources management in Jordan are mainly intermittency of water supply to households and other users. In addition, water and sanitation services are subsidized by the government which needs to improve utilization efficiency, maximizing wastewater collection and minimizing non-revenue water (NRW). Moreover, policy measures have been adopted to halt deterioration of groundwater water quality resulting from depletion and to mitigate the impacts of declining water flows in wadis and springs.[58]

The water sector in Egypt is characterized by water scarcity and increasing demand due to population growth and related socioeconomic activities. The country is almost completely reliant on the Nile River for its water resources, with a dependency ratio estimated at 97 per cent.[59] The Nile is shared between 10 countries and with Egypt's position being the most downstream country it is highly impacted by upstream developments. Moreover, the country suffers from a water deficit of up to 54 billion cubic metres (bcm) of water annually[60] and its total renewable freshwater resources lie below the global water scarcity threshold of 1000 m^3/capita/year. In addition to water scarcity, the major challenges of the water sector are: water security, overuse of groundwater, deterioration of coastal areas and vital ecosystems due to water pollution, fragmented and centralized institutional framework and the adverse impacts of climate change, particularly on the Nile River and coastal areas.[61]

In Tunisia, water resources are characterized by severe scarcity as the annual total renewable freshwater resources are below the absolute water scarcity threshold of 500 m^3/capita. Moreover, the country's water resources are not equally distributed on the national geographical scale. The northern areas have the main source of surface water, the Medjerda River, while many groundwater sources are concentrated in the south and fewer water resources are available in the centre of Tunisia which has led to mobilizing the available water resources to meet the demand of water-deficit areas.[62] The country also suffers from water stress, reported under SDG indicator 6.4.2, whereby freshwater withdrawal as a proportion of available freshwater resources was at 94 per cent in 2014.[63] The scarcity and variability in water resources availability is exacerbated by the extreme impacts of climate change. A study for selected extreme temperature and precipitation indices in identified shared water basins of the Arab region, was performed within the framework of RICCAR. Whereas extreme temperature indicators have shown definite increasing trend in hot and very hot days for mid and end of the century, trends in forecasted extreme precipitation indices were less consistent.[64]

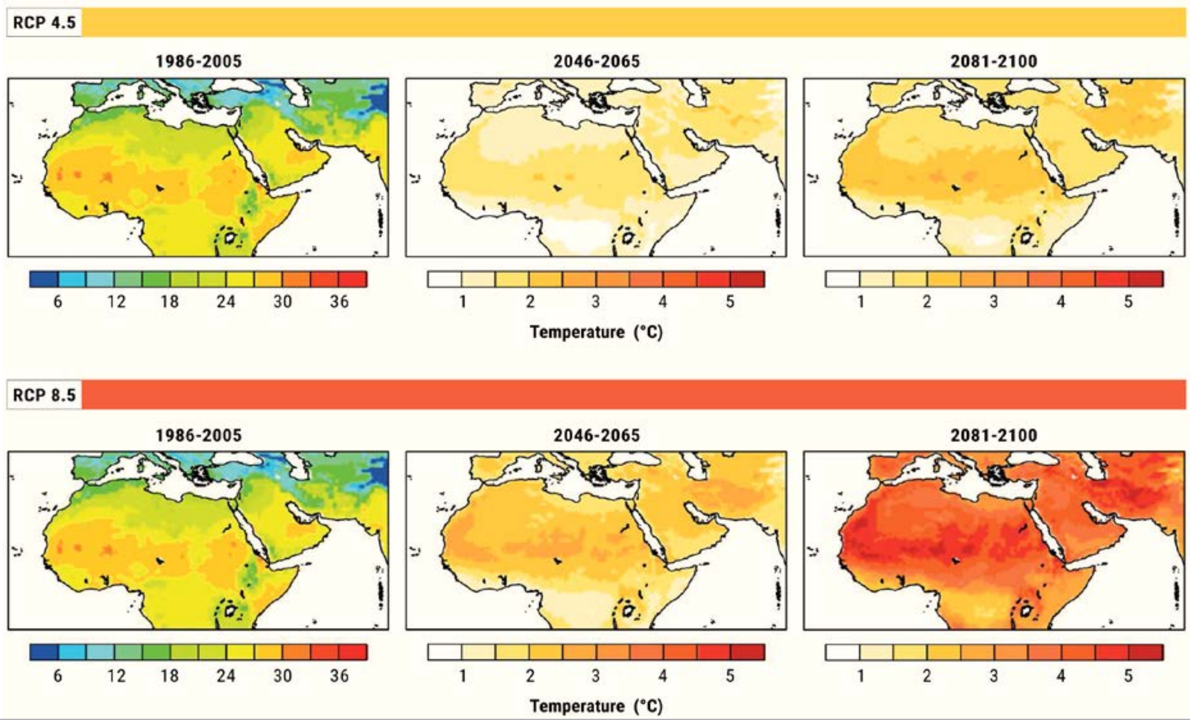
D. Impacts of climate change on water resources

The Arab region is currently witnessing severe impacts of climate change including floods, droughts, heatwaves, change in precipitation intensity, increasing frequencies of extreme events in addition to sea level rise that threatens coastal areas. ESCWA in coordination with other United Nations and League of Arab States organizations and international centres conducted the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socioeconomic Vulnerability in the Arab region (RICCAR) as the first integrated assessment carried out on the Arab domain.[65]

The climate change projections conducted in RICCAR show that the impacts of climate change on the water-scarce Arab region will be manifested in higher temperature and decreased precipitation, as shown in figure 5 and figure 6. The effect of the change in those climatic parameters was determined by comparing the forecasted mid-century (2046-2065) and end-of-century (2081-2100) periods with the 1986-2005 baseline period. The general change in temperature towards the end of the century shows an increase in the mean annual temperature in the Arab region of 1° to 3°C for representative concentration pathway (RCP) 4.5, and of 2° to 5°C for RCP 8.5.[66] However, there are large regional differences across the Arab region for both RCP 4.5 and RCP 8.5 scenarios which was reflected in the analysis for various subdomains.

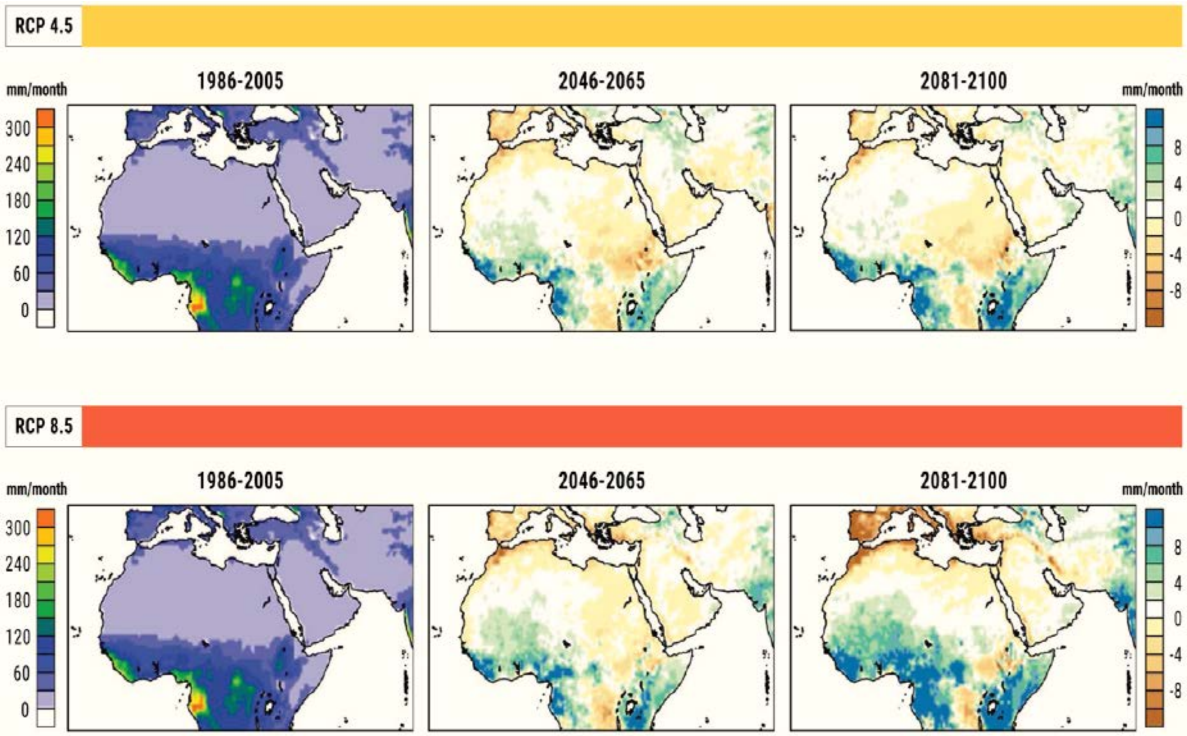
Average precipitation in the Arab region is generally projected to decrease towards the year 2100 but showing large spatial variability compared to change in average temperature. For instance, figure 6 shows that, by the end of the century, both scenarios indicate a reduction in average monthly precipitation, reaching 8-10 mm in the coastal areas of the domain, mainly around the Atlas Mountains in the west and the upper Euphrates and Tigris river basins in the east. These changes in precipitation are similar to changes in run-off and water availability using various regional hydrologic models across the Arab region and exhibit large differences between subregions.

Figure 5. Change in average temperature (°C) for the time periods 2046-2065 and 2081-2100



Source: ESCWA, 2017d.

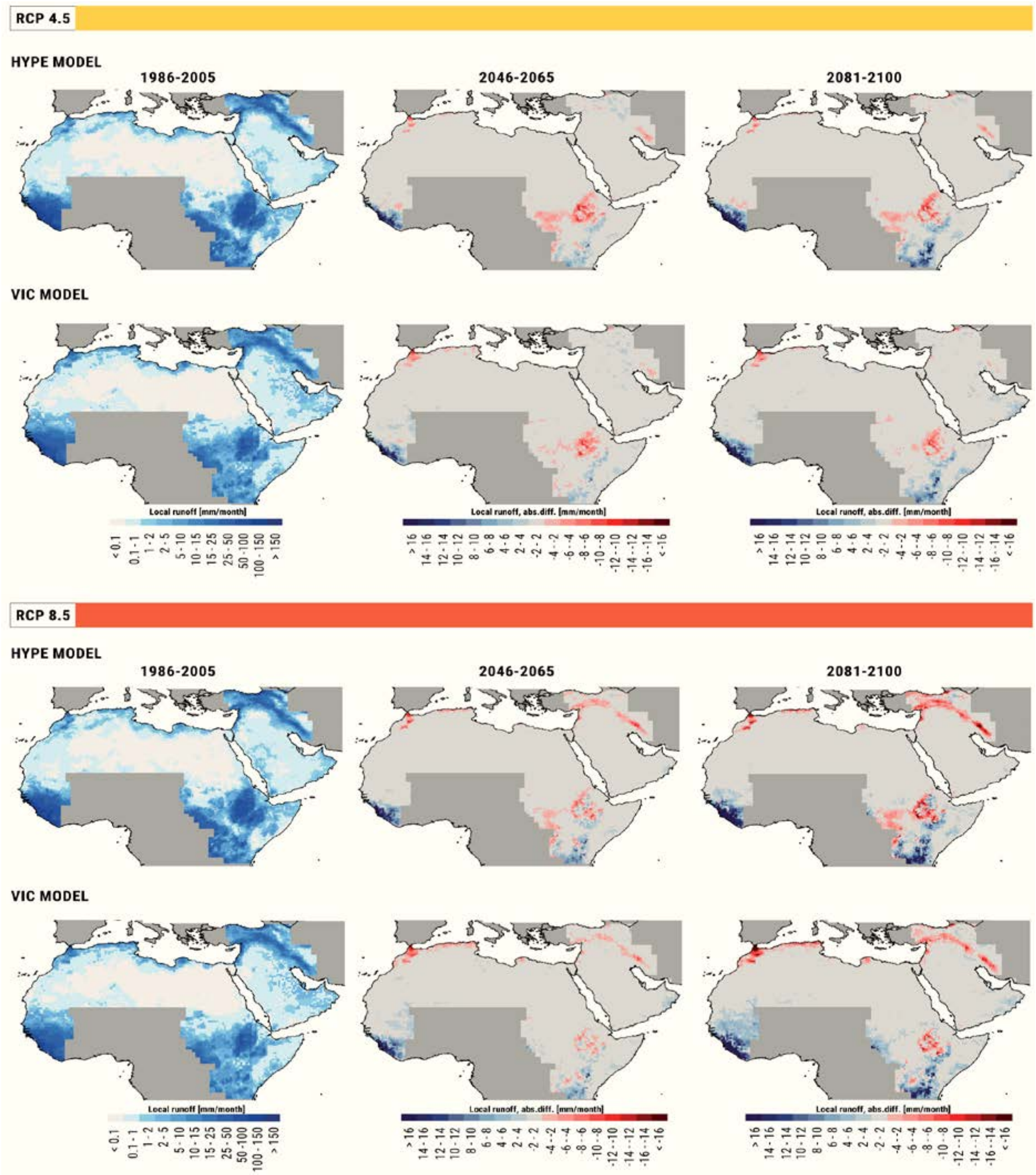
Figure 6. Change in average precipitation (mm/month) for the time periods 2046-2065



Source: ESCWA, 2017d.

The different hydrological models applied under RICCAR provide the results of projections for specific parameters and are expressed in terms changes in area run-off over the Arab region as shown in figure 7. Changes in run-off largely follow the same pattern as changes in precipitation. There is a clear reduction in run-off along the northern coasts of Morocco, Algeria and Tunisia, as well as in some subregions in the Tigris and Euphrates basins. In the Nile basin, there are mixed patterns of decrease and increase in surface run-off. These parameters can be used, along with extreme precipitation indices, to develop better estimates of availability of water resources on a basin or country levels. In Chapter 3, different model outputs and projections for mid-century compared to a reference period (1986-2005) will be analysed. Outcomes of the analysis aim to assist water planners to better understand the implications of changes in projected climatic and hydrological parameters using scenarios identified under the Intergovernmental Panel on Climate Change (IPCC). This will help a better understanding of changes in water availability trends and how water resources management approaches can address water availability challenges in different identified subdomains and hotspots of the Arab region.

Figure 7. Change in run-off (mm/month) for the time periods 2046-2065 and 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5 using two hydrological models



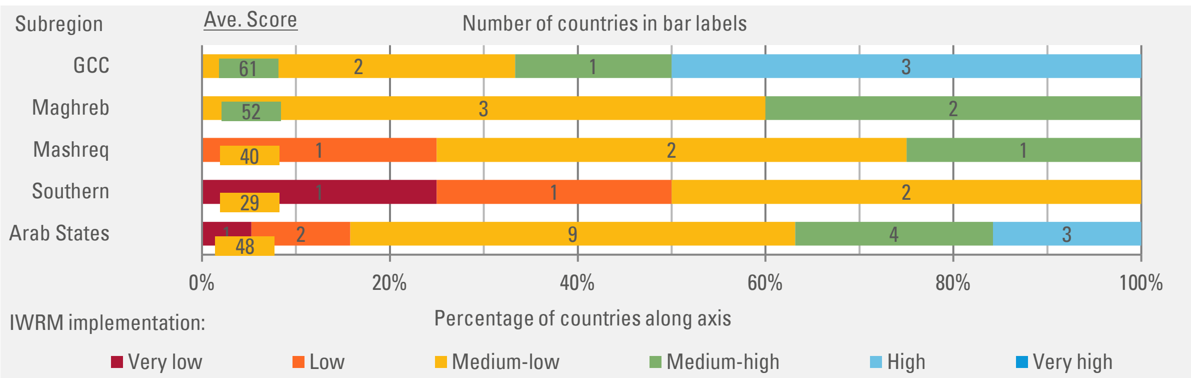
Source: ESCWA, 2017d.

E. Integrated water resources management

Many Arab states continue to face challenges in implementing integrated water resources management (IWRM), largely due to lack of policy coherence and weak governance structures. For instance, the assessment of progress on IWRM implementation (namely SDG indicator 6.5.1) for 19 Arab countries (figure 8) shows that no Arab countries reported a very high level of IWRM implementation (91-100), although three countries did report a high level of IWRM implementation (71-90), which means they are generally achieving policy objectives for IWRM with good geographic coverage and stakeholder involvement. Four Arab countries were classified as having medium-high level of IWRM implementation (51-70), which indicates that these countries are generally implementing elements of IWRM and that they have adequate capacity to implement these elements under long-term programmes. Conversely, reporting from nine Arab countries demonstrated a medium-low level of IWRM implementation (31-50), meaning that elements of IWRM are generally institutionalized and are towards implementation, but require strengthening. Three Arab countries scored a low level of IWRM implementation, which indicates that those countries started developing elements of IWRM, but with very limited geographic coverage and stakeholder engagement. A very low level of IWRM implementation signifies that the development of elements of IWRM has generally not begun or has ceased. However, it should be noted that the score is affected by the inclusion of shared water resources management in the questionnaire sheet on indicator 6.5.1, and since several Arab States have not signed shared water resource agreements, their score related to SDG 6.5.1 will naturally drop.

Consequently, two thirds of the Arab countries surveyed anticipate that they will not be able to meet the global ambition set for the SDG indicator 6.5.1 by 2030. Moreover, wide disparities among countries of the Arab region were found, even among those with comparable socioeconomic characteristics.[67] Therefore, intraregional cooperation and exchange of experience and best practices among various Arab countries should be encouraged to foster efficient institutional arrangements for IWRM.

Figure 8. IWRM implementation in Arab subregions



Source: ESCWA, 2019b.

* Country data available from UN-Water and United Nations Environment Programme, 2018b.

In order to enhance efficiency of water governance, there is a need for coherent frameworks established across the Arab region at the national level to coordinate water-related laws, policy and strategies. Priorities should be given to the establishment of governing bodies at the lowest possible management level to ensure better integration of public participation with a focus on mainstreaming gender objectives. Particular attention should be given to an effective governance and the operationalization of water management instruments at subnational, aquifer and basin management levels, including information-sharing and water quantity and quality monitoring. In addition to public budget allocation at the national, subnational and basin levels for water development investments, cost recovery constraints pose a real challenge to securing the appropriate financial sources needed to operationalize IWRM at the country level. Therefore, financing should be made available for the development, mobilization and deployment of financial resources with due consideration to management of transboundary water resources. Cost recovery for the water services delivered has been a controversial issue in the Arab region, therefore efforts to implement and maintain cost recovery scheme should take into consideration the social and economic considerations to ensure affordability and that no one is left behind.

Governance and institutional settings in the context of IWRM

The first two dimensions under indicator 6.5.1 provide insights on water governance and institutional settings, in the context of IWRM, in the Arab region. Table 3 shows the survey dimensions that countries responded to regarding the enabling environment and institutions and participation.

Table 3. First and second dimensions of SDG indicator 6.5.1 on IWRM implementation

	Enabling environment	Institutions and participation
National level	Policy Law Plans	Authorities Cross-sectoral coordination Capacity Public participation Business participation Gender objectives
Subnational	Policy	Gender objectives
Basin/aquifer/local	Basin/aquifer management plans	Basin/aquifer organizations Local public participation
Transboundary	Management arrangements	Organizational arrangements Gender objectives
Federal countries only	Provincial water law	Provincial authorities

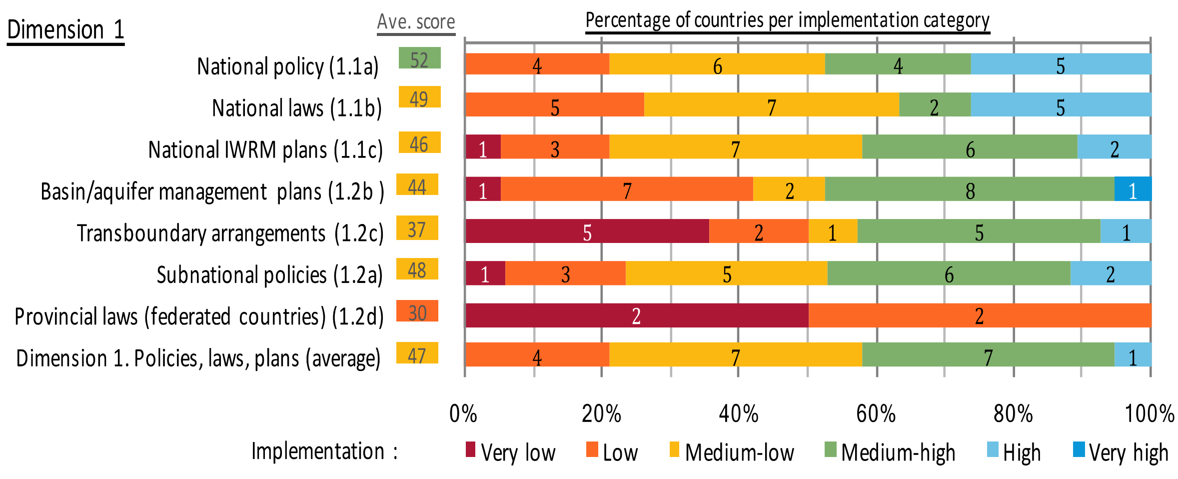
Source: UN-Water and United Nations Environment Programme, 2018b.

The highest implementation score is found for the dimensions of institutions and participation (51), while the lowest scores are recorded for the enabling environment (47). This reveals that there is good multi-stakeholder participation in support of IWRM implementation by the different institutions as well as good awareness among decision-makers of the importance of the methods and tools for better water management actions. However, the low level of enabling conditions, including policy, laws and strategic planning, seems to hinder the implementation of IWRM especially in the light of the lack of and/or improper utilization of financial resources for improving water management nationally.

Many Arab countries appear to be facing serious challenges in implementing some of the enabling environment elements (figure 9). Excluding the element for federal countries, on average 10-12 countries are in the medium-low and low implementation categories for developing and implementing laws, policies and plans. Development of transboundary arrangements seems to be the weakest element in the Arab region where five countries scored in the very low level of IWRM implementation.

As water is a cross-cutting sectoral issue, the laws related to water management are often established by a variety of ministries, such as water, agriculture, health and environment. The challenge is for national governments to find and pursue the right framework for coordination, planning and management of water resources through a participatory, coherent approach. Chapter 4 will explain further the institutional arrangements of the water sector in Arab region as it studies the mainstreaming of water-related SDGs in national development and water strategies. Country-specific case studies will highlight the institutional mechanisms in place for implementing and monitoring water-related targets and indicators in the context of sustainable development.

Figure 9. Implementation of dimension 1 of enabling environment for IWRM in the Arab region



Source: ESCWA, 2019b.

* Country data available from UN-Water and UN Environment Programme, 2018b.

F. Private sector engagement in water service delivery

Public-private partnerships (PPP) are considered a key mechanism and an important tool to fill the financing gap and to achieve the SDGs.[68] The private sector is instrumental and has the capabilities and expertise for supporting government agencies in enhancing human skills and technical capacities needed for the operation and maintenance of water supply and sanitation systems.[69] Private sector involvement undertaken within the framework of PPPs can take a wide range of arrangements, varying in the degree of involvement and risk taken by the private party. In addition, PPPs can alleviate the large public funds invested in the water sector that are typically associated with insufficient economic returns.

Nevertheless, the private sector remains reluctant to engage in the delivery of water-related services in many countries of the Arab region due to, among others, typically low returns generated from the sector; lack of accurate national data and information-sharing; high capital investments involved for the long-term range; and the political instability which characterizes many countries in the region.

Also, local populations often oppose private sector engagement in water and sanitation service delivery. Privately owned companies are perceived to value economic and financial feasibility over social and environmental concerns. Furthermore, foreign actors could be granted greater control over water resources which are considered a public good and could disproportionally increase vulnerability of the poor, further exacerbating existing inequalities.

G. Localizing water development technologies to the Arab regional context

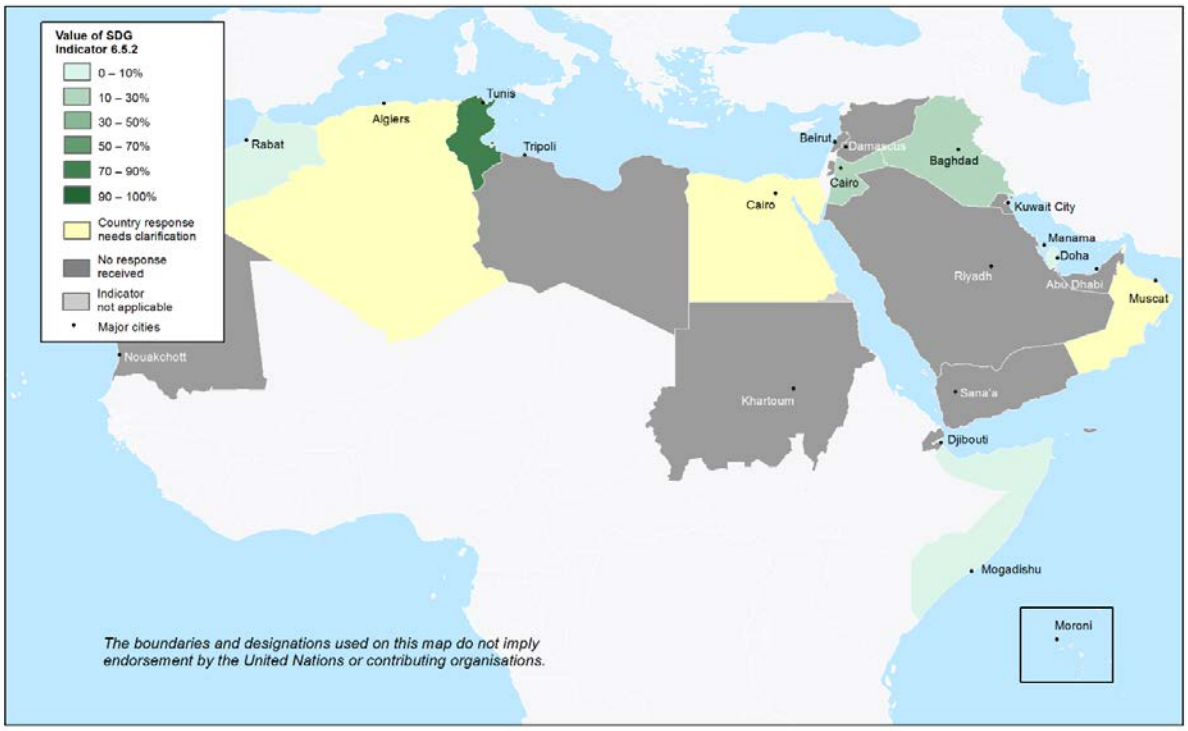
Despite heavy reliance on desalination technologies to meet increasing demands on scarce freshwater resources, there has been limited effort in the Arab region to advance scientific research and development to adapt imported technologies to the national and local context.[70] The Arab region has typically relied on the import of water technologies with local input limited to the implementation of operation and maintenance activities.[71] Investments for the localization of desalination technologies adapted to the specificities of the Arab context are disproportionate with the growing demand for desalinated water.[72] This is thought to have caused lost opportunities in terms of added value to national economies and employment generation.[73] According to the Patent Landscape Report on Desalination Technologies and the Use of Alternative Energies for Desalination, patents for innovate approaches in desalination from the Arab region have only been recorded in Egypt, Morocco and to a lesser degree in Saudi Arabia and Lebanon.[74]

H. Management of shared water resources

Out of the 21 Arab countries sharing groundwater and/or surface water resources with another country, only nine reported under SDG indicator 6.5.2 (figure 10). Although the number of Arab countries included in the above analysis is small, results show different levels of advancement in cooperation on surface waters and cooperation on transboundary groundwater aquifers. Cooperation on the latter is still a particular challenge and is lagging behind surface waters. Operational arrangements for transboundary aquifers are still rare worldwide and cooperation on aquifers has not been integrated enough in the cooperation on surface waters.[75] It should also be noted that this methodology ought to be complemented by a qualitative analysis, as it has proven difficult for the Arab countries to provide sufficient data on their shared water resources. This qualitative analysis should include information on the effectiveness of the operational arrangements,[76] status of data-sharing among riparian countries, existence of joint monitoring systems and projects and future common plans and visions to better reflect the status of the operational arrangements.

Furthermore, this low response rate on indicator 6.5.2 reflects some specificities of the Arab region on shared waters regarding situations of occupation and of armed conflict, where water resources fall under foreign control and are impacted by instability. For instance, among the states that did not submit a response for both indicators 6.5.1 and 6.5.2 are State of Palestine and the Syrian Arab Republic. Another major obstacle to reporting on shared waters is the water scarce conditions in most Arab states and the associated perception of water security in the region that further inhibits the willingness to share information on shared water resources. Other challenges include lack of studies on shared groundwater resources and the lack of dedicated financial resources for reporting, monitoring, and management of shared waters.

Figure 10. Country response on SDG indicator 6.5.2 in the Arab region



Source: ESCWA, 2018a.

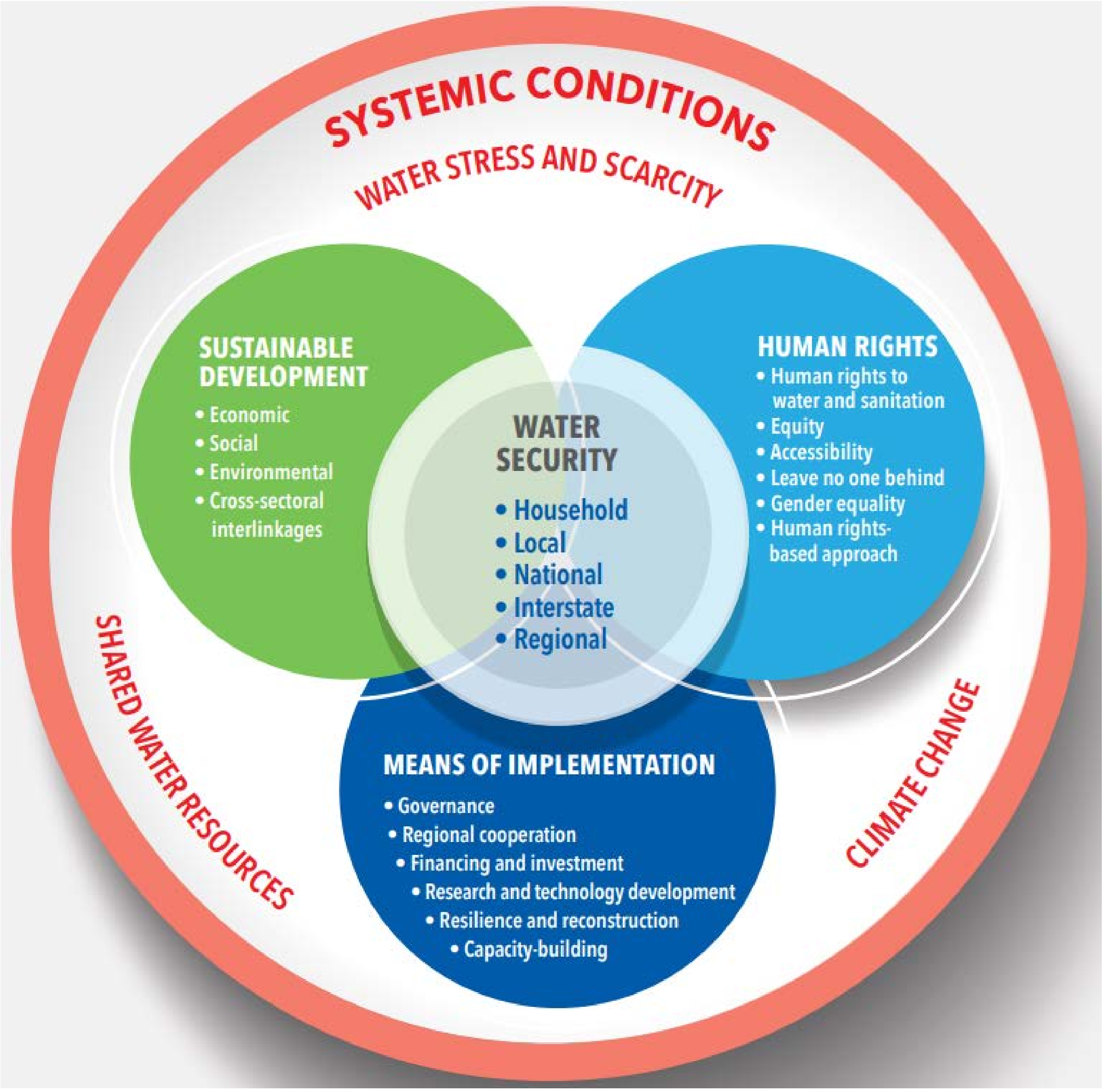
I. Water security

The scarcity of water resources in the Arab region combined with other pressing factors, such as population growth, urbanization trends, inequality, conflict, occupation, shared water resources and impacts of climate change, requires a holistic framework for moving towards achieving water security in the region. In this context, the ESCWA publication "Moving Towards the Implementation of Water Security in the Arab region" provided a conceptual framework to achieve water security in the region through a human rights-based approach (figure 11). It examined the implications of water security at different levels, including the household and community levels, and recommended an equitable, inclusive and participatory approach to ensure that no one is left behind. This participatory approach aims to empower women and the most vulnerable groups to be active participants in demanding their rights to managing water resources. Also, given the centrality of water to sustainable development in its three dimensions and to the water-related SDGs, as explained in chapter 1, sustainable development plays an integral role in the holistic framework for water security in the region. The framework also allows for greater transparency and accountability which could benefit the Arab region and avail more financial resources from the private sector and the international community. In addition, the conceptual framework identifies several means of implementation based on the region's priorities for moving towards achieving water security.

Considerations and challenges to achieving water security vary according to scale and scope. On a global scale, water security issues include, but are not limited to, climate change, virtual water trade flows, technology transfer and global conventions.[77] At a regional/interstate level, the challenges depend on the regional specificities related to water endowments, shared water resources, migration and refugee flows as well as regional strategies and conventions. For example, the Arab Strategy for Water Security aims to meet the challenges and future needs for sustainable development between 2010-2030. The strategy also consolidates the Arab approach to overcoming challenges in water resources development and management in the region.

At national and local levels, Arab States should consider water security needs of their citizens through proper policies and decrees that ensure equality and the right of all to water and sanitation as well as social development and economic prosperity. At the household level, accessibility to freshwater in sufficient quantity and quality, affordability and consumption practices of the household members are important factor to be considered for water security.[78]

Figure 11. Conceptual framework for water security in the Arab region



Source: ESCWA, 2019a.

Projecting Water Scarcity in the Context of Climate Change

3. Projecting Water Scarcity in the Context of Climate Change

It is important to understand the scope and magnitude of variability in water availability caused by the impacts of climate change especially in the context of the Arab countries that are facing chronic water shortages. Such information would support decision-makers and the various groups of stakeholders in achieving better water resources allocation among the competing water uses in different sectors. Existing information and analysis on projected variations in water availability across the Arab countries, when available, is scattered and disconnected. Previous studies to assess impacts of climate change on water resources have typically focused on specific sectors, most notably the agricultural sector. Furthermore, previous methodological approaches were based on statistical analysis calculated for annual averages over coarse spatial resolutions rather than hydrological modelling forecasts. One of earlier studies aiming at a comprehensive assessment of changes in water availability, supply and demand as a result of forecasted variability in population growth, economic development and climate change was commissioned by the World Bank for FutureWater.[79] The study outcomes highlighted trends in declining water availability across the MENA region.

In line with the objective of this publication, this chapter aims to link RICCAR climatic and hydrologic modelling outcomes generated for the Arab domain with their impacts on water availability. The analysis is used as a basis to inform operational plans based on a science-policy interface that considers SDG interlinkages. Run-off forecasts are used as a proxy to assess future water availability for mid-century under a moderate climate change scenario and the worst-case climate change scenarios.

A. Projected changes in water supply in the Arab region

A few studies were conducted to address the forecasted changes in water supply by taking the impacts of climate change into consideration. For example, a revised version of the PCR-GLOBWB hydrological model[80] developed under the FutureWater study[81] was used to assess current and future water availability by taking into account variations in soil, land cover and topography. The analysis was performed by considering the entire hydrological cycle components and processes including evapotranspiration, groundwater recharge and run-off. The model outcomes were used to determine water resources availability as a result of climatic factors (climate change) and socioeconomic factors (agricultural demand). The climate change scenario used was the A1B scenario which is considered as an intermediate scenario between the low and high greenhouse gases (GHG) emissions scenarios.[82] The A1B which was considered by the IPCC assumes a world of rapid economic growth, global population that peaks in mid-century and rapid introduction of new and more efficient technologies.

The model forecasts provided an assessment of the changes in renewable water resources. While both renewable water resources and groundwater recharge are expected to decline across the study area, the greatest declines were forecasted for the recharge component. This can be explained by the impact of increased evapotranspiration and the non-linearity of hydrological processes. This should be particularly significant for countries with limited rainwater endowments that rely on groundwater as their primary source of water. The water resources availability for both surface and groundwater resources for the reference period (2000-2009) and projected period (2040-2050) is shown in table 4 for selected Arab countries based on the FutureWater study.

Table 4. Available renewable water resources including groundwater and surface water for baseline years (2000-2009) and projected yearly average for the period 2040-2050 (mcm)

	2000-2009		2040-2050	
	Surface Water	Groundwater	Surface Water	Groundwater
Algeria	4 622	1 733	4 903	3 487
Bahrain	14	16	7	1
Egypt	47 470	5 509	50 154	5 879
Iraq	31 634	7 526	25 423	3 521
Jordan	193	67	170	18
Kuwait	306	203	231	183
Lebanon	829	231	869	110
Libya	1 612	2 512	1 117	1 214
Morocco	10 440	3 208	6 899	1 911
Oman	663	101	505	61
State of Palestine Gaza Strip	11	11	11	1
West Bank	50	80	77	8
Qatar	125	116	105	44
Saudi Arabia	7 285	3 687	5 025	1 400
Syrian Arab Republic	14 612	376	12 181	2 045
Tunisia	2 059	413	1 800	1 816
United Arab Emirates	169	164	144	55
Yemen	3 777	663	3 780	660
Total	125 871	26 616	113 401	22 414

Source: Adapted from Immerzeel, 2011.

The hydrological modelling outcomes have highlighted a substantive decrease in surface water and groundwater for most Arab countries under study by the year 2050 as compared to the baseline values. Exceptions include Algeria, Egypt and the Syrian Arab Republic. In the Syrian Arab Republic, the groundwater recharge will increase fivefold, nevertheless, the total renewable water resources will decrease since inflows from the Euphrates River in Iraq are expected to decrease by 17 per cent according to the applied methodology. The availability of surface and groundwater resources is forecast to decrease by 10 and 16 per cent, respectively, by 2050 for the 17 Arab countries included in the study. The total reductions in total renewable water resources are estimated at 11 per cent over the same period of time (see table 6 for changes in volumes in million m^3). The study concluded that while population and economic growth factors are the main drivers behind the increased shortages in water supply over the study area, climate change was estimated to contribute to more than 20 per cent of the gap between water supply and water demand. This means that climate change is expected to further exacerbate the stress on the already limited water resources for their various uses.

B. Projected water availability based on run-off projections developed under RICCAR

This section aims to understand the changes in water availability as a result of the impacts of climate change based on the outcomes of hydrological modelling generated under RICCAR. Regional climate and hydrological modelling for the Arab domain have resulted in maps depicting the projected percentage change in surface run-off using different scenarios towards the end of century. In this analysis, the change in run-off over the Arab domain was used as a proxy for change in water supply and availability.

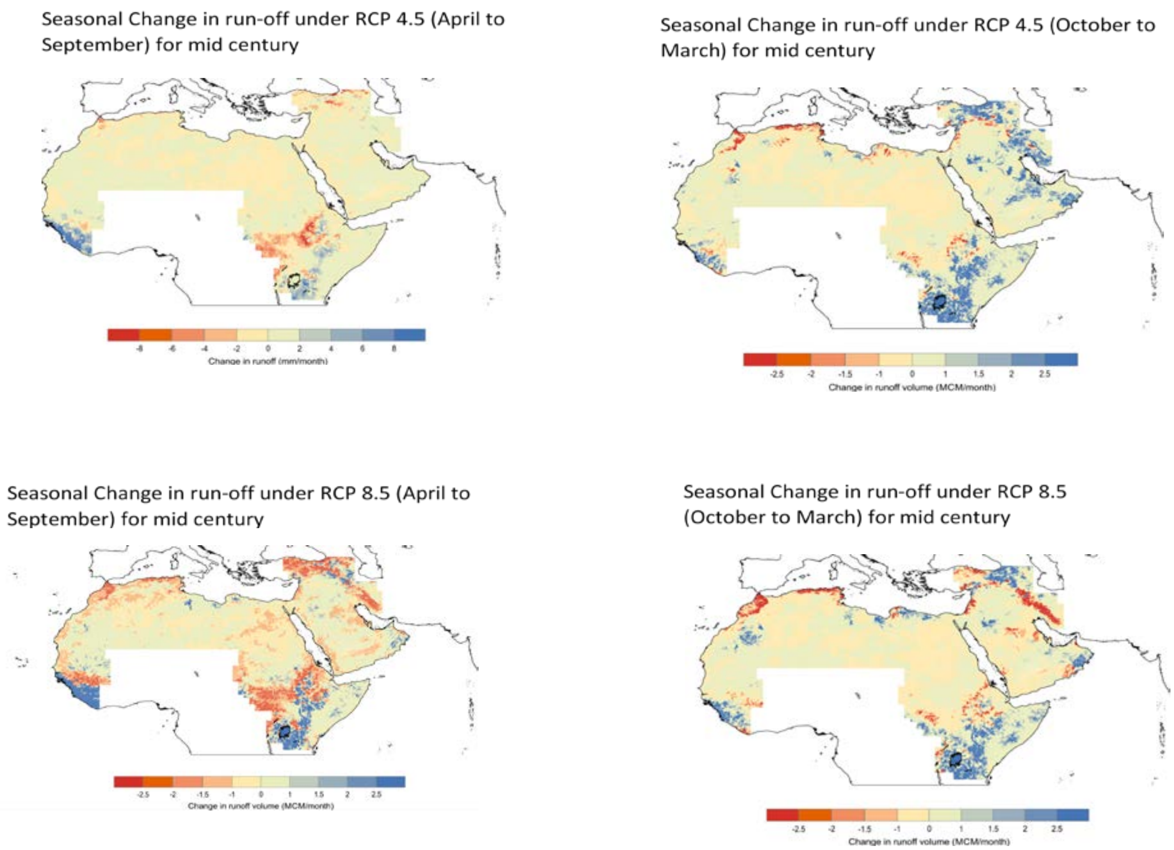
Surface run-off for the Arab region was obtained in RICCAR by applying two hydrological models: Hydrological Predictions for the Environment (HYPE) and Variable Infiltration Capacity (VIC) models. HYPE is based on the sub-basin level as the analysis unit using catchment parameters such as topography and land use, soil type and elevation classes for each sub-basin. The water balance for each class is calculated individually before being combined to estimate the balance for each sub-basin. VIC is a large-scale, semi-distributed hydrological model based on 50 x 50 km grid cells where the water balance is modelled independently for each cell. Both models used bias-corrected regional climate modelling (RCM) outputs obtained from three different Global Circulation Models (GCMs) and global databases: CNRM-CM5, EC-EARTH, and GFDL-ESM2M. Hydrological modelling outputs were reported as an ensemble mean whereby results from the outputs based on the three different GCMs are averaged and reported.[83] Projected change in run-off for the Arab region was based on the annual mean for the period 2030-2050, compared to a baseline period of 1986-2005.

Mean change in run-off was reported both annually and seasonally, based on two seasons of six-month periods each, April to September and October to March. The annual change in volumes was also reported for the same period and was calculated by multiplying the hydrological modelling outputs for each sub-basin or grid cell (for HYPE and VIC, respectively) by its area.

Hydrological modelling outcomes of RICCAR for the annual average change in run-off compared to baseline values (1986-2005) show a considerable reduction in water availability across the Arab region. This is in agreement with the outcomes of other regional studies that have predicted severe water shortages all over the Arab region.[84] The mean change in seasonal run-off volumes (mm/month) for the period 2030-2050 for projection ensembles generated under a moderate (RCP 4.5) and a pessimistic climate change scenario (RCP 8.5) are presented in figure 12 as well as table 5 and table 6. Building on these outcomes, more detailed analysis was pursued in this chapter to develop a better understanding of the magnitude of these implications over each of the sub-domains identified under RICCAR (figure 13).

In doing so, the results draw upon regional data to formulate conclusions and recommendation regarding the applicability of alternative options for water management at the national and local levels.

Figure 12. Seasonal mean change in run-off (mm per month) for mid-century (2030-2050) for ensemble of three RCP 4.5 and RCP 8.5 generated under HYPE model compared to reference period (1986-2005)



Source: ESCWA, 2017d.

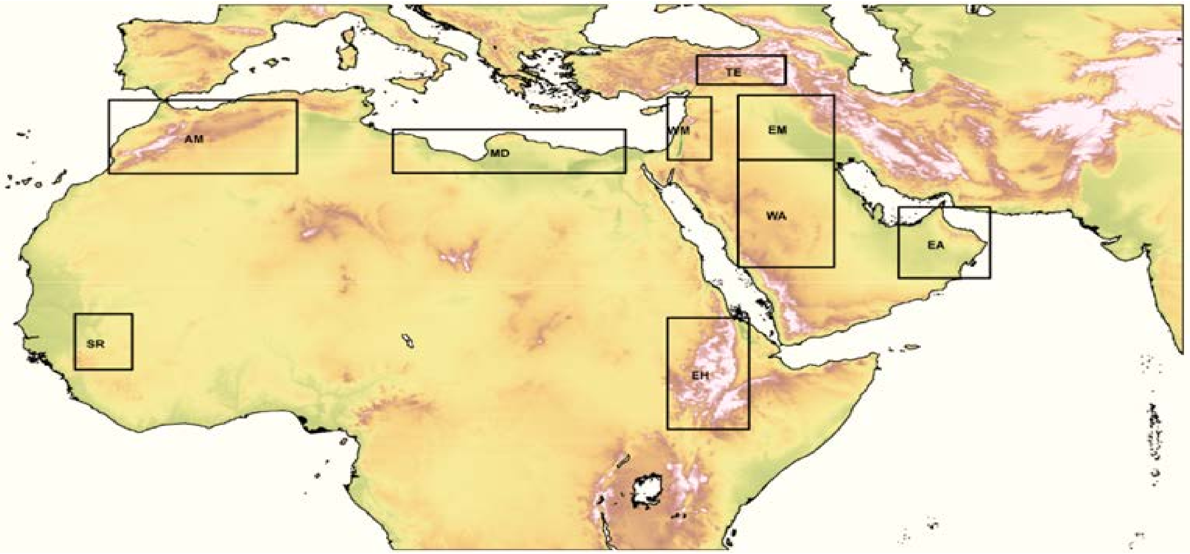
1. Quantifying water availability changes for the identified subdomains

Changes in run-off volumes (mm/month) were calculated for the entire Arab domain based on monthly averages computed on seasonal basis. Projections of extreme weather indicators (more details will be given in the following section) were also performed for the entire Arab domain (figure 14 and figure 15).

For a more in-depth analysis of changes in water availability over particularly significant regions over the Arab domain from the hydrological perspective, the study has identified seven subdomains for more detailed analysis in line with RICCAR methodology (table 5 and figure 13). The percentage change in run-off compared to baseline values as well as the changes in total volumes of water over these subdomains were calculated and are provided in table 6 and table 7, respectively.

The information generated from both run-off and extreme weather indices projections contributed to a better understanding of the combined effects of the variation in these factors under various climate change scenarios.

Figure 13. RICCAR subdomains



Source: ESCWA, 2017d.

Table 5. RICCAR subdomains of the Arab domain

Subdomain	Surface area (km^2)
Atlas Mountains (AM)	1 313 750
Mediterranean Coast (MD)	691 854
Western Mashreq (WM)	240 994
Tigris-Euphrates Headwaters (TE)	312 559
Eastern Mashreq (EM)	699 430
Western Arabian Peninsula (WA)	1 064 750
Eastern Arabian Peninsula (EA)	435 449

Table 6. Projected mean change in surface run-off for mid-century (2030-2050) for ensemble of three RCP 4.5 and RCP 8.5 projections compared to reference period, 1986-2005

Subdomain	Climate Change Scenario	Seasonal percentage mean change in run-off (percentage) April to September		Seasonal percentage mean change in run-off (percentage) October to March		Seasonal mean change in run-off (mm per month) April to September		Seasonal mean change in run-off (mm per month) October to March	
		HYPE	VIC	HYPE	VIC	HYPE	VIC	HYPE	VIC
Atlas Mountains	RCP4.5	-15	-15	-10	-10	-0.18	-0.33	-0.29	-0.29
	RCP8.5	-30	-15	-30	-30	-0.36	-0.33	-0.87	-0.87
Baseline values (mm)		1.2	2.2	2.9	2.9				
Mediterranean Coast	RCP4.5	Nil	Nil	-5	0	0	0	-0.145	0
	RCP8.5	25	10	5	15	0.15	0.17	0.145	0.375
Baseline values (mm)		0.6	1.7	2.9	2.5				
Western Mashreq	RCP4.5	5	5	-5	5	0.11	0.295	-0.405	0.39
	RCP8.5	-5	0	-10	-5	-0.11	0	-0.81	-0.39
Baseline values (mm)		2.2	5.9	8.1	7.8				
Tigris-Euphrates HW	RCP4.5	-5	Nil	5	5	0	0.895	-1.19	0
	RCP8.5	-5	-5	5	5	0	0	-0.5	-0.75
Baseline values (mm)		23.8	21.6	19.2	14.2				
Eastern Mashreq	RCP4.5	10	15	5	20	0.33	0.93	0.32	1.14
	RCP8.5	5	5	-5	0	0.165	0.31	-0.32	0
Baseline values (mm)		5	5	-5	0				
Western Peninsula	RCP4.5	15	120	35	110	0.075	0.6	0.28	0.88
	RCP8.5	10	10	-10	20	0.05	0.05	-0.08	0.16
Baseline values (mm)		0.5	0.5	0.8	0.8				
Eastern Peninsula	RCP4.5	35	70	55	85	0.385	0.98	0.825	1.7
	RCP8.5	40	30	45	55	0.44	0.42	0.675	1.1
Baseline values (mm)		1.1	1.4	1.5	2				

Source: Based on ESCWA, 2017d.

Table 7. Projected mean change in volumes of surface run-off (mcm per month) across seasons for mid-century (2030-2050) compared to reference period, 1986-2005

Subdomain	Climate change scenario	April to September mcm/month		October to March mcm/month	
		HYPE	VIC	HYPE	VIC
Atlas Mountains	RCP 4.5	-227	-394	-338	-368
	RCP 8.5	-455	-455	-956	-1024
Mediterranean Coast	RCP 4.5	-1	-5	-77	15
	RCP 8.5	87	87	155	297
Western Mashreq	RCP 4.5	15	90	-5	98
	RCP 8.5	-18	-18	-150	-50
Tigris Euphrates Headwaters	RCP 4.5	-306	22	439	267
	RCP 8.5	-467	-467	363	376
Eastern Mashreq	RCP 4.5	197	698	352	828
	RCP 8.5	113	113	-171	89
Western Arabian Peninsula	RCP 4.5	95	700	317	1,019
	RCP 8.5	53	53	-53	183
Eastern Arabian Peninsula	RCP 4.5	161	397	347	661
	RCP 8.5	171	171	304	455

Note: Negative sign indicates a reduction in run-off relative to the reference period.

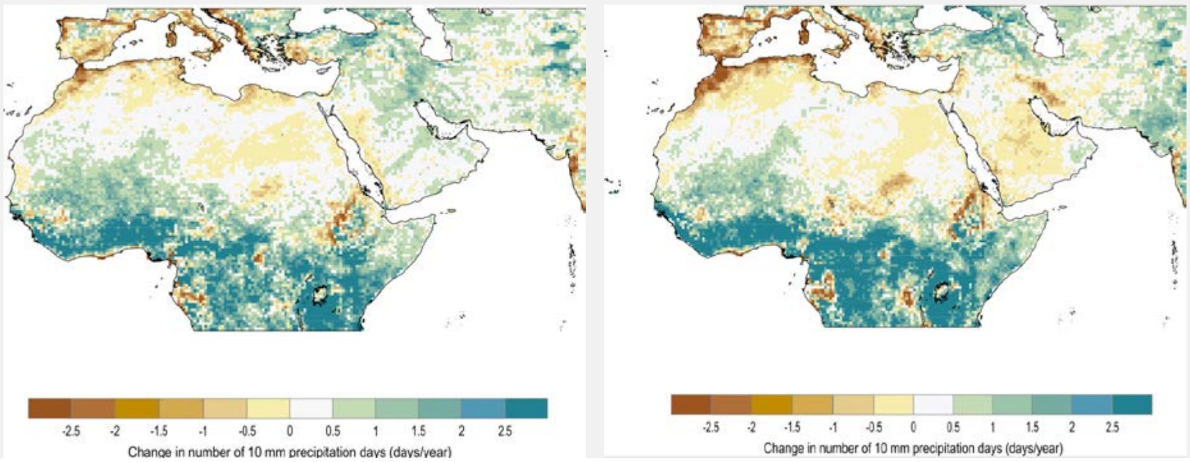
2. Extreme weather indices

In order to complement the information generated by RICCAR regarding forecasted changes in surface water run-off, an analysis for two extreme precipitation indices was pursued. The first is the change in annual number of days when daily precipitation is greater than 10 mm (R10), which provides information on the change in number of days with heavy rainfall. The second is the change in Simple Precipitation Intensity Index (SDII), which calculates the variation in the ratio of annual total precipitation to the number of wet days (more than 1 mm). The outcomes of projections for the extreme weather indices are provided in figure 14 and figure 15. The maps showed significant increases in SDII in south eastern parts of Arabian Peninsula (such as Oman and southern Saudi Arabia) under both scenarios; as well as in western and middle Sahara and the northern coast of Egypt. While for R10, a dominant decrease in the values of this index can be observed in most of the areas, particularly at the Atlas Mountains, Upper Nile Basin and Arabian Peninsula for the high-end scenario (namely RCP 8.5).

Figure 14. Mean annual change in the number of 10 mm precipitation days (R10) (days/yr) for ensemble of three RCP 4.5 and RCP 8.5 projections by mid-century compared to reference years

(a) Mean annual change in R10 days under RCP 4.5

(b) Mean annual change in R10 days under RCP 8.5

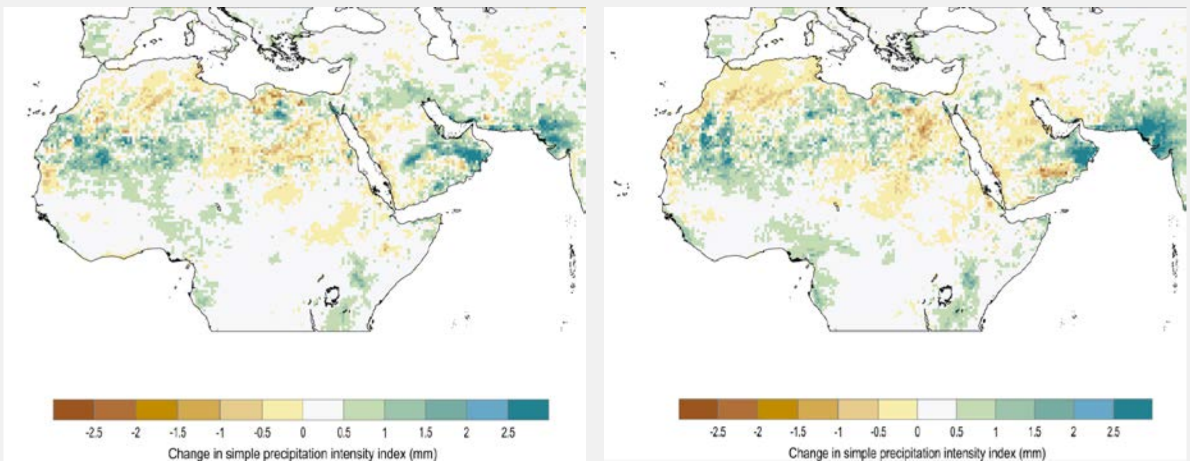


Source: ESCWA, 2017d.

Figure 15. Mean annual change in the Simple Precipitation Intensity Index (SDII) (mm) for ensemble of three RCP 4.5 and RCP 8.5 projections by mid-century compared to reference year

(a) Mean annual change in Intensity Index under RCP 4.5

(b) Mean annual change in Intensity Index under RCP 8.5



Source: ESCWA, 2017d.

3. Eastern Mashreq

For the Eastern Mashreq subdomain which is located in the eastern part of the Arab region and coincides with the area of confluence of the Tigris and Euphrates rivers, projected water supply is expected to increase considerably over large parts for the moderate scenario (RCP 4.5) of the identified area during the summer and winter seasons (up to 15-20 per cent increase). The more pessimistic scenario (RCP 8.5), however, has yielded markedly drier conditions (change ranging from 5 to -5 per cent) as shown in table 6.

An analysis of the volumes of run-off forecasted for the Eastern Mashreq subdomain have generated limited monthly additional run-off which do not exceed 1.4 mm per month in winter compared to 1 mm per month in the summer season under the VIC model for the medium scenario (RCP 4.5). Nevertheless, these figures should be considered with caution since the increase in total volumes of water received over the entire subdomain might have significant impacts. For instance, total additional forecasted run-off volumes generated under the milder climate change scenario vary based on the hydrological model used from 200 to 700 mcm during summer and from 350 to 830 mcm for the winter seasons. These changes are forecasted at considerably lower levels under RCP 8.5 ranging from a decrease of 171 mcm per month to additional run-off volumes not exceeding 100 mcm per month (table 7).

To better understand the implication of the additional volumes of run-off received, the outcomes of projections in extreme weather events are included in the analysis. Projections of extreme weather indicators (figure 14) indicate an increased number of days with heavy rainfall (R10) and more intense precipitation patterns for the moderate climate change scenario. It should be noted that rainfall intensity has a significant impact on the volumes of groundwater recharge with higher intensities found to result in lower recharge rates. Furthermore, change in groundwater recharge is not commensurate with the variation in rainfall intensity, as several studies have shown that small increases in rainfall intensities generates magnified decreases in groundwater recharge.[85] Therefore, additional water supply in Eastern Mashreq is thought to be linked to increased incidence of intense flash floods and would lead to reduced groundwater recharge and the ensuing loss of surface run-off to open water surfaces. Soil erosion which can have detrimental impacts on crop cultivation is another concern in the study area. Thus, it was assessed that additional and intense storm rainwater received is expected to cause more damage than benefits to agricultural production.[86] Furthermore, intensive rain occurring over short periods of time in this region was found to be linked to the formation of sediment deposits in lakes and reservoirs and hence further reductions in surface water storage capacity and exacerbating losses in the increasingly scarce water resources.[87] This area is undergoing the second fastest rate of groundwater storage loss in the world.[88] The main reason for the decline in groundwater levels is attributed to the decrease in precipitation and pumping at unsustainable rates that exceed recharge capacities.

Managed aquifer recharge is emerging as an important policy response to the forecasted additional water volumes expected with great temporal and spatial variability. This alternative is a particularly relevant option for this part of the Arab region in countries like Iraq, because it can contribute to the replenishment of the depleted groundwater systems. However, few hydrogeological studies have been conducted regarding the suitability of local soil formations for groundwater recharge in Iraq. Additional storage capacities are needed to capture storm waters in this area. Local experts have confirmed the importance of such policies to address the fluctuations in water supplies and to facilitate water storage for subsequent use in drier seasons.[89] Additional research and studies are still needed however, to assess the feasibility of managed aquifer recharge as a local climate change adaptation approach using national and local data.

Moreover, it is important to note that more than two thirds of the renewable water resources in Iraq originate from outside the country. Upstream countries are continuously expanding water infrastructure development which exacerbates Iraq's vulnerability to the climate change induced water variability. Strong interlinkages exist between groundwater and surface water resources in the Euphrates and Tigris basin system, both of which are depicting declining trends. Recent reports state that the water discharge in the Tigris and Euphrates rivers will dramatically decrease by 2040.[90] In response, the national medium- and long-term water resources management strategy of Iraq should focus on the development of alternative water resources as shown in the RICCAR projections above.

The expansion of desalination is viewed as an inevitable water management response measure for this subdomain. In Iraq, the scope of the implementation of desalination should not be limited to seawater but would also be needed to treat the increased salinity in the Tigris and Euphrates river waters. As such, the Basra municipality in Iraq has initiated an agreement for the construction of a Reverse Osmosis (RO) desalination plant planned for a 199,000 m^3/day capacity serving 400,000 people from the region.[91]

Kuwait, a country located in this subdomain, relies heavily on desalination to address water demand from the various groups of consumers and has placed desalination at the core of its water management strategy. In addition, Kuwait is pioneering wastewater treatment in the Arab region. All wastewater collected is being treated to safe levels and used in its entirety in the agriculture sector,[92] while there is a managed aquifer recharge (MAR) pilot research by Kuwait Institute for Scientific Research (KISR) being carried out using this quaternary treated wastewater.

Nevertheless, in order to harness the full potential of wastewater as a resource in countries of this subdomain, better coverage in wastewater collection networks should be pursued. In the case of Iraq, only 40 per cent[93] of the urban population is served with wastewater collection networks while most of the population living in rural areas depend on on-site sanitation facilities. Furthermore, entire volumes of safely treated wastewater, representing 67 per cent of the total collected, are discharged into surface watercourses.

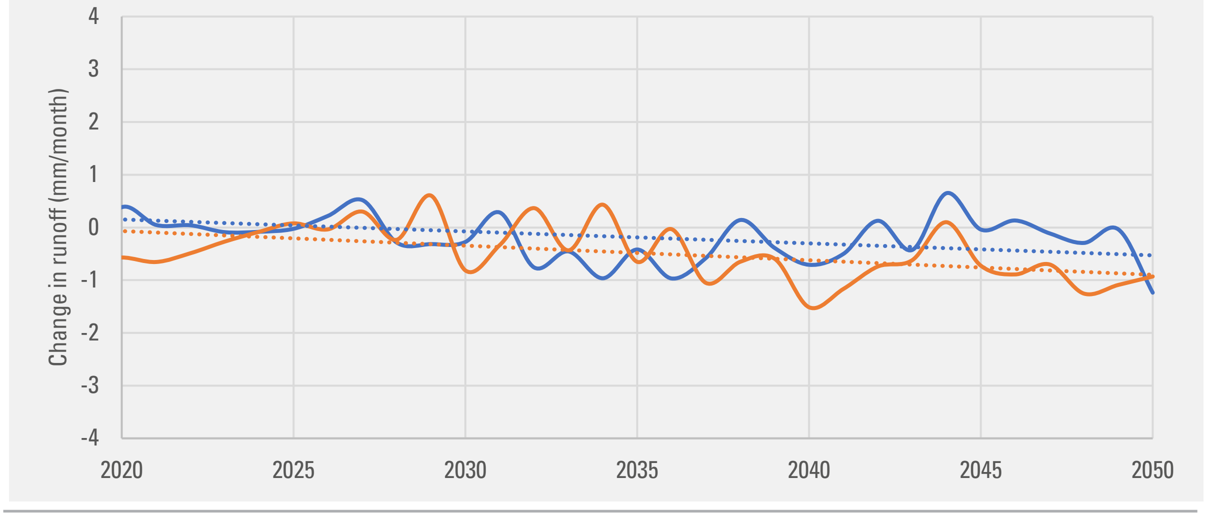
The prevalence of off-network sanitation systems represents a real challenge facing sustainable wastewater management and for the prevention of contamination available ground and surface water. Therefore, national water development policies and strategic priorities should focus on expanding the scope of wastewater infrastructure in countries located in the Eastern Mashreq region for subsequent treatment and use to address the forecasted shortcomings in water supply as shown above.

4. Atlas Mountains

The Atlas Mountain subdomain covers most of Morocco and the northern part of Algeria. There are definitive trends of decreased water supply as depicted by the maps for run-off over this subdomain. Changes in run-off under the moderate climate change scenario were projected at 10 to 15 per cent decrease in run-off for summer and winter seasons by 2040, respectively. The worst-case scenario (RCP 8.5) has yielded water supply reductions that were projected to range from 15 to 30 per cent for summer and reaching up to 30 per cent in winter under both hydrological models used in this analysis (table 6). These elevated rates of change in water supply should be carefully interpreted since the actual reductions in seasonal run-off do not exceed 1 mm per month. Nevertheless, the expected total reductions in volumes of water over this subdomain are high with increased reductions expected in winter compared to the summer season.

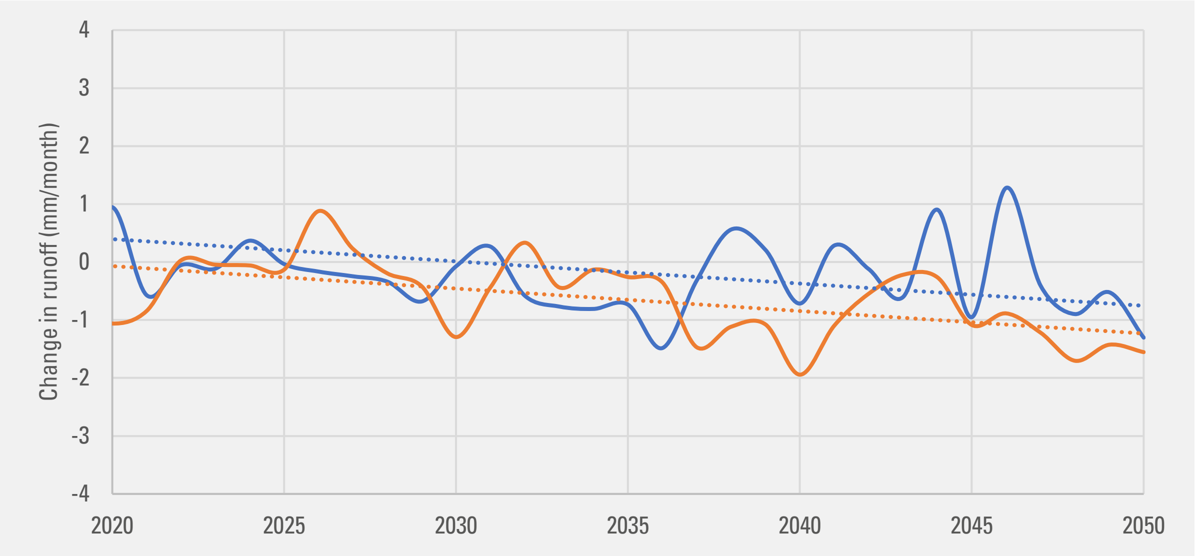
The projected reductions in surface water run-off were assessed at around 350 million cubic meters for the moderate climate change scenario (RCP 4.5) to 1 billion cubic meters under the worst-case scenario (RCP 8.5) for the winter season under both hydrological models used (table 7). The shortages in water supply over the summer season were markedly lower and varied from 230 to 400 mcm per month for the moderate climate change scenario (RCP 4.5) based on the hydrological model used and up to about 450 mcm per month for the more pessimistic climate change scenario (table 7). Furthermore, a trend of sustained decrease in water availability is forecasted until the mid-century in this already water scarce coastal regions of this subdomain (figure 16 and figure 17).

Figure 16. Mean seasonal change (April-September) in run-off for mid-century for RCP 4.5 and RCP 8.5 ensembles using VIC compared to reference period



Source: ESCWA, 2017d.
Notes: RCP 4.5: blue line; RCP 8.5: orange line; for three-member ensembles for RCP 4.5 and RCP 8.5.

Figure 17. Mean seasonal change (October-March) in run-off for mid-century for RCP 4.5 and RCP 8.5 ensembles using VIC compared to reference period



Source: ESCWA, 2017d.
Notes: RCP 4.5: blue line; RCP 8.5: orange line; for three-member ensembles for RCP 4.5 and RCP 8.5.

In view of the outcomes of the regional hydrological models applied to this subdomain, water augmentation strategies should be at the centre of the policymaking and decision-making processes for the North African countries of the Arab region. Therefore, in addition to the expansion in water demands expected as a result of economic development and demographic growth, national development planning should take into consideration shortages in renewable water resources as a result of climate change. National strategies have been focusing on construction of dams, seawater desalination, wastewater treatment for agricultural and industrial use purposes. Desalination seems to present an inevitable solution to increasing water shortages. Algeria has had extensive experience in building RO desalination plants across the country to face increased water shortages. The country launched in 2014 what is thought to be the largest RO desalination plant in the African continent with a capacity of 500,000 m^3 per day. In addition, Algeria has extensive experience in the construction of small surface water harvesting and recharge dams as a mean to optimize the use of available renewable water resources. Morocco is pioneering desalination plants powered by renewable energy. The country has launched the Chtouka-Aït Baha seawater desalination plant in July 2018 which is considered the world’s largest RO seawater desalination project operating on concentrated solar power (CSP) plants.[94]

Also, the use of wastewater as a resource should be expanded in the countries of this subdomain. More than 85 per cent of the urban population in Morocco and Algeria are connected to the wastewater collection system, while rural population connectivity was reported at drastically lower levels and not exceeding 10 per cent. Furthermore, only 4 and 18 per cent of the collected wastewater is safely treated in Morocco and Algeria, respectively.[95] Only a fraction of the safely treated wastewater is used in Algeria for agricultural purposes whereas the remaining volumes are discharged to surface water courses.

Olive trees, an important source of income in the Maghreb region, are particularly vulnerable to water shortages. The Atlas Mountains also includes wheat cultivations that are expected to be directly impacted by the projected water shortages. Some attempts to shift to the less water-intensive barley crops were met with reluctance since it is primarily perceived as a fodder crop and because of its lower nutritional value. Despite these difficulties the cultivation of barley might expand in light of the predicted severe shortage in water.[96]

As such, further research should be pursued to understand the social and economic implications of water shortage assessments in the various sectors. Policy interventions should mainly focus on the expansion of desalination as well as wastewater collection and treatment infrastructure, augmenting wastewater treatment and its subsequent use for irrigation.

5. Eastern Arabian Peninsula

This subdomain is located on the south eastern part of the Arabian Peninsula. Mapping depicts that water supply in this region will be highly affected by worsening climate change scenarios. Despite large disparities among the outcomes of the hydrological models applied, it is obvious that large areas of this region will receive additional surface run-off under the moderate scenario. This trend is much less obvious under the worst-case scenario. The findings can be further corroborated by the projected water run-off volumes as shown in table 7. The Eastern Arabian Peninsula subdomain shows the highest percentage increase in water run-off compared to other studied subdomains, reaching up to 70 and 85 per cent increase under moderate climate change scenario, compared to baseline values for summer and winter, respectively. These values correspond to additional average projected run-off volumes ranging between 0.4 mm to 1.7 mm per month for the summer and winter seasons, respectively. This trend in increased water supply is observed under the maximum scenario (RCP 8.5) but to a lesser extent. When the entire subdomain is taken into consideration, the total volumes expected over this area under the moderate climate change scenario vary from more than 150 to 400 mcm per month during the summer to 350 to more than 650 mcm per month for winter seasons based on the hydrological model used. The volumes of additional run-off forecasted are markedly lower for the high-end scenario varying from 170 mcm per month in summer season to values varying between 300 and 450 mcm per month forecasted for the winter season (table 7).

These forecasted volumes of additional run-off received can potentially have a far-reaching impact based on precipitation patterns. Forecasts for extreme weather indices for the area under study, show increased prevalence in the number of heavy rainfall (R10) with higher precipitation intensity (SDII) (figure 14 and figure 15). The change in extreme weather indices is greater for the moderate climate change scenario compared to the more pessimistic climate change scenario.

In light of the discussion in previous sections related to the expected decrease in recharge with higher intensity rainfall and the expected increase in forecasted extreme weather in this subdomain, increased frequency of flash flooding events and other water-related disasters are expected. Also, it should be noted that factors such as the impact of human development activities were not accounted for in the hydrological models. Most notably this includes the probable expansion in urbanization and its associated increase in impermeable sealed surface areas hindering water infiltration and hence potential groundwater recharge. The outcomes of the projections are in line with the higher frequency of cyclones causing severe flash floods and water-related disasters experienced over the past decade in Oman and in the south east areas of Saudi Arabia. Flooding and associated economic losses were also attributed to inefficient storm water drainage infrastructure and limited investments in rainfall harvesting and groundwater recharge techniques.

Traditional water augmentation strategies in this part of the Arab region have focused on desalination and wastewater treatment. The above figures indicate the potential for harvesting larger water volumes especially in the context of the limited rainwater endowment for most countries of the region. Despite the existence of some forms of traditional water harvesting in the Arab region, the efficiency of rainfall utilization is considered quite limited for most countries of the Arab region. Table 8 shows the rate of rainwater utilization in selected Arab countries and highlights the need for further expansion of its use.

Table 8. Percentage of rainfall utilized compared to total volumes of rainfall received in selected Arab countries

Country	Volume of rainfall received per year (*BCM/year*)	Per cent volume harvested through water harvesting (*Percentage*)
Jordan	8.5	5
Tunisia	36	2.6
The Sudan	1 000	0.4
Morocco	150	1.3
Syrian Arab Republic	85	2.4
Yemen	68	9
Algeria	192	3
Mauritania	175	2.5
Egypt	15	1.5

Source: Abdo and Eldaw, 2004.

The main limitation for further expansion of the use of water harvesting techniques in the Arab region is the great variability in temporal and spatial geographical distribution in precipitation. Successive drought years usually result in the failure of the water harvesting systems. On the other hand, flash floods have the potential to destroy water harvesting infrastructure. A solid understanding of the hydrological processes and interactions among the various components of hydrological processes have still not fully emerged.

Experience from the Arab region regarding the construction of detention and recharge dams to alleviate the impacts of flash floods and enhance the efficient use of water available for agriculture and domestic purposes have demonstrated that returns on investment can be achieved within few years after execution of the infrastructure works.[97] In addition, Managed Aquifer Recharge (MAR) is important especially in urban areas where impermeable surfaces such as asphalt and concrete hinder the percolation and infiltration of water into the ground. Traditionally some types of indirect run-off storage have been practiced in the Arab region. Water spreading is one that has been practiced in Saudi Arabia, Yemen, Oman and the United Arab Emirates.[98, 99] In Qatar, water is collected in shallow depressions and directed through wells into underlying aquifers.

Studies assessing the social and economic feasibility of groundwater recharge with desalinated and treated wastewater in countries of the subdomain have been conducted in various parts of the Arabian Peninsula. In Oman, for example, hydrogeological assessments have confirmed the suitability of the aquifer along the northern coast of Oman (Al-Khawd Aquifer) for recharge management options.[100] Similar research has been conducted in Abu Dhabi based on a decision-making support tool that has confirmed that the storage capacity of alluvium aquifers in the Al-Ain basin can accommodate large volumes of recharged water.[101] Besides, current practices are focusing on the recharge of depleted and neglected groundwater aquifers with desalinated and treated wastewater in countries of the Arabian Peninsula. Oman uses 6 per cent of the safely treated wastewater[102] in groundwater recharge as a means to redistribute water surplus generated from wastewater treatment in periods of low water demands (winter) to seasons of water shortages (summer). In the context of the increased volumes of run-off projected under the various climate change scenarios, additional assessments and pilot projects should be implemented to assess the feasibility of redirecting storm water into aquifers for better redistribution of the scarce water resources and to manage extreme rainfall events that are expected as shown in the above projections until mid-century. There is also a need to upgrade the existing drainage network system and expand the scope of its coverage to adapt to more frequent and intensive extreme rainfall events in this area of the Arab region. Hence the full scope of storm water management options should be considered, including urban storm water management.

6. Western Arabian Peninsula

The western Arabian Peninsula subregion is concentrated in the central western part of the Arabian Peninsula. Regional hydrological model projections indicated great variability in trends over this region. The north-western part is expected to experience additional run-off, whereas south-eastern parts of this subdomain seem to be prone to more dryness, especially along the Arabian Gulf shores and during the summer season.

The projected run-off increases for the western Arabian Peninsula subdomain under the moderate scenario (RCP 4.5) shows a wide variability depending on the hydrological model applied ranging from 15 to 120 per cent in the summer season and 35 to 110 per cent for the winter season (table 6). The worst-case scenario (RCP 8.5) generated lower rates of change in run-off and considerably lower variability in run-off generated by the two regional hydrological models for both summer and winter compared to RCP 4.5. Despite the limited amounts of additional water volumes expected in this area, the patterns and frequency with which additional water volumes are received is a source of concern. Using the VIC hydrological model and under the moderate climate change scenario (RCP 4.5), additional surface run-off volumes projected over this area vary from 700 mcm to 1 billion cubic meter per month for the summer and winter seasons respectively. The same hydrological model generated much lower forecasted additional run-off varying from 50 to around 200 mcm per month under the more pessimistic climate change scenario (table 7). This is the region where the difference between forecasted run-off volumes generated by the two hydrological models was the highest. The HYPE hydrological model yielded much lower projected run-off volumes than those predicted by the VIC model.

Brackish groundwater reserves along the eastern shores of the Red Sea located in the Saudi Arabia are being exploited but cannot produce enough to become a sustainable reliable water source and hence additional water development options will be needed to address the growing demands for the different types of water uses in this area.[103] For this reason, water planning and management should integrate objectives that account for the projected water shortages while accommodating eventual episodes of intense rainfall and water supply.

Desalination is a significantly relevant option for this subdomain with further efforts needed to localize imported technologies to the local context while harnessing the plentiful solar energy to power desalination units. In addition, wastewater treatment and reuse are important avenues for water augmentation strategies. The Gulf countries of Bahrain, Qatar, Saudi Arabia and the United Arab Emirates are treating most of the wastewater collected to safe levels. Nevertheless, collection rates are especially low in remote areas and should be improved to make use of the full potential of wastewater as an alternative water resource. United Arab Emirates and Qatar use more than two third of the treated wastewater while wastewater reuse in Saudi Arabia and Bahrain is much lower. Most of the treated wastewater is used in the agricultural sector while unused volumes are discharged into water courses. One main obstacle for wider use of treated wastewater in this subregion is the public reluctance for use of treated wastewater especially at the household level.[104]

7. Western Mashreq

This area is located on the western shores of the Mediterranean Sea extending to the northern parts of the Arabian Peninsula. Water supply in term of surface run-off shows a great variability for this region based on the hydrological models used. The two models applied have generated large variations in water availability between the moderate and high-end climate change scenarios. Whereas slight increases in summer water availability are expected under RCP 4.5, the worst-case scenario RCP 8.5 generally shows decreases in surface run-off.

A decreasing trend is noted for the region in that forecasted percentage reductions in water availability are greater for winter (ranging from -5 to -10 per cent) compared to the summer season, as observed for both climate change scenarios. In other words, while the moderate climate change scenario yields greater variation in water supply trends (ranging from 5 per cent decrease in winter to 5 per cent increase in summer), the high-end scenario outcomes support a consistent decrease in water supply (table 6).

Forecasted climate change and its associated reductions in water availability are expected to transform areas cultivated under dryland conditions to rangelands, specifically in the north western region of Jordan and the headlands of the Euphrates and Tigris as well as Iraq and the Syrian Arab Republic. In addition, water availability is expected to decrease over this region with possible increases in summer run-off under the moderate climate change scenario.

These areas are cultivated with wheat which means that livelihoods dependent on the staple crop will suffer tremendously from the impacts of climate change. Olive trees are the main rain-fed crop in Jordan, the Syrian Arab Republic and the State of Palestine and are highly susceptible to the impacts of climate change. Olive yields are expected to decrease by 65 to 90 per cent under RCP 4.5 and by more than 90 per cent under RCP 8.5 by the end of the century throughout the Mashreq region.[105]

Jordan, one of the most water-stressed countries of the world, is pioneering water augmentation solutions at the Arab regional level. All the volumes of collected wastewater are treated to safe levels and around 90 per cent of these are used, mostly in agriculture.[106] Nevertheless, only 60 per cent[107] of the urban population in Jordan is connected to the wastewater network system and hence investments should be directed towards expanding the existing wastewater collection infrastructure to enhance the potential use of wastewater as an additional non-conventional water resource. Furthermore, Jordan has been exploring the potential application of managed aquifer recharge (MAR) to alleviate water shortages and as a climate change adaptation measure as this practice was found feasible along the lower reaches of the wadi catchments and along the foot hills of the Jordan Rift Valley.[108] The alluvial aquifers in these regions have high storage capacities and water surplus can be directed to the Dead Sea or the Gulf of Aqaba to counteract and/or alleviate the drop in water table and declining water levels around the Dead Sea.

In Lebanon, the Beirut Artificial Recharge Project demonstrated the efficiency of water storage in aquifers to improve the temporal and spatial distribution of water supplies. Similar studies have shown that aquifers can potentially store up to 40 per cent of infiltrated volumes in identified groundwater basins of Lebanon (for example, Sarafand-Khaldi cretaceous basin).[109] As such, national priority for countries located in this region should focus on increasing water supply measures such as reuse of treated wastewater and desalination while exploring the potentials of water harvesting and storage in underground layers.

8. Mediterranean Coast

Both hydrological models used have shown an increasing trend of run-off generation in many parts of this region under the worst-case climate change scenario. Contrary to what one might expect, while the moderate climate change scenario has resulted in constant run-off rates compared to baseline years, the worst-case scenario has yielded increased run-off volumes that are expected to reach higher rates during the summer compared to winter seasons. For the RCP 8.5 scenario, increases in volumes ranged from 10 to 25 per cent in summer while for the winter season they ranged between 5 to 15 per cent (table 6). The overall quantities of expected additional summer run-off over the entire subdomain, under the more pessimistic scenario, have reached around 90 mcm per month generated under both hydrological models. This is compared to baseline years and further increased to range from about 150 to 300 mcm for the winter season based on the hydrological model used (table 7).

The northern coastal region in Egypt which is a part of this subregion, has one of the earliest experiences in the world in water harvesting and many of the water collection tanks ranging in capacity from 200 to 2000 cubic meters are still operational.[110, 111] Further improvement and expansion of rainwater harvesting and collection infrastructure is needed to enhance the efficient use of rainwater endowments over this area to support livelihood and small-scale agricultural activities. Existing small water regulating structure in the area can further support groundwater recharge.

The Nile Delta located just south of the Mediterranean coast subdomain requires special consideration since it is considered among the most vulnerable regions in the world to the impacts of raising sea levels.[112] Nevertheless, this region is also expected to receive additional water supplies in the rate of 0.1 to 2 mm per month, which presents a potential resource if this water is correctly harvested.[113] Supplementary irrigation methods (meaning both rain-fed and irrigated methods) can be utilized more as a key measure for efficient water management in this area.

Figure 18. Constructing a cistern for water harvesting

Source: *FAO, 2018.*

Furthermore, analysis has demonstrated the applicability of desalination projects in coastal areas located along the Mediterranean coast because they are tourist areas and can afford the cost.[114] Feasibility assessments have shown that it is more economical to treat water through desalination than to undertake extensive water supply infrastructure works to convey water from the Nile to remote areas.[115] Furthermore, regions with the highest projected decline in water availability include a high concentration of touristic centres where cost recovery for the unit water generated can support desalination. Desalination in coastal areas in Egypt is currently used for domestic water purposes and the expansion of the scope of their use in industry and agriculture is linked to advancements in membrane technologies and cost of power sources. In addition, the Government policies support the engagement of both the public and private sectors in the desalination industry and private sector has already contributed to the introduction of RO technology in touristic centres on the coastal areas to keep up with the expanding domestic water demands.

Similarly, desalination of seawater along the coastal areas of Libya, which is in the Mediterranean subdomain, was deemed as an inevitable solution by national experts as well. There is also a high potential for desalination for brackish groundwater aquifers distributed in the coastal towns.[116]

C. Recommended actions for achieving the science-policy interface

In view of the projections showed in this chapter, the mid-century forecasts generated for various climate change scenarios strongly indicate that some regions of the Arab region will be more vulnerable to worsening climate change conditions than others. In some subdomains identified across the Arab region, projected percentage increase in run-off was higher in summer compared to winter seasons, especially when the more pessimistic scenario is considered. These regions include the Eastern Mashreq and the Mediterranean Coast. Forecasts of winter water supply shortages are higher than those of summer, notably in the Atlas Mountains and the Western Mashreq subdomains of the Arab region. The difference between the forecasted percentage change in run-off generated by the two hydrological models was highest for the Western Arab Peninsula. This indicates that this area has the highest susceptibility to the type of hydrological model used and hence additional research is suggested to improve accuracy of projected changes in water availability over this subdomain.

Human development, such as urbanization, in the Arab region suggest further decreases in infiltration and natural groundwater recharge which means higher occurrence of flash floods. The forecasted figures for percentage change in surface water run-off were used as a proxy for assessing water availability across the Arab domain. Additional information related to the changes in potential groundwater recharge as well as variations in extreme weather indices were also considered for a better understanding of the impacts of climate change on water supply in the region until the period 2030-2050.

In many parts of the Arab region, the variability in water supply and availability between the summer and winter seasons will lessen under worsening climate change scenarios. This will mean drier winters and increased incidence of flash floods and surface run-off during the summer season. In many subdomains the moderate climate change scenario generates increased run-off forecasts compared to the baseline values: these increases are lesser for the maximum climate change scenario. There are also some disparities among the outcomes generated using various hydrological models and under various climate change scenarios, therefore, more research and models maybe used in such case to develop an ensemble of results that would incorporate more physical processes and represent interaction between surface and groundwater flows. The following are recommended policy actions based on the scientific results presented in this chapter:

- Previous assessments have shown that even when all demand management alternatives are implemented, there will still be a demand gap that would exceed 90 bcm over the entire Arab region.[117] Therefore, the enhancement of the efficient use of renewable water resources and water augmentation strategies are indispensable in the Arab region;
- RICCAR provided an initial regional assessment for water availability and potential surface run-off and groundwater recharge at various areas and subdomains. Further follow-up research is still needed at

smaller scale of analysis across the Arab region to generate more accurate data on fluctuations in water availability. The resulting information would provide guidance for the development of national and local policies on appropriate climate change adaptation measures such as for example, building of recharge dams in areas where floods and storms are expected;

- The main limitation for further expansion of the use of water harvesting techniques in the Arab region is the great temporal and spatial variations in precipitation. Successive drought years usually result in the failure of the water harvesting systems, while flash floods have the potential to destroy water harvesting infrastructure;
- A solid understanding of the hydrological processes and interactions among the various components are still not fully investigated. Therefore, additional data and information is needed regarding the volumes of run-off and rainfall, hydrological approaches and techniques suited to the conditions of arid regions and upscaling experience gathered from local water harvesting and recharge projects to larger scales;
- Climate change is expected to exacerbate the divide between rain-fed subsistence agriculture and irrigated lands. Mapping these areas will assist water planners to define appropriate policy measures for utilizing supplementary irrigation and developing more water-efficient cropping patterns in identified hotspot areas;
- There is a need to enhance hydrological monitoring systems in the region to create a reliable regional database on run-off, river discharge, rainfall variability, flooding, sedimentation, evapotranspiration and groundwater recharge that would improve accuracy of regional hydrological modelling. Limited run-off observations were available to calibrate and validate the hydrological models used in RICCAR;
- To bridge the gap between supply and demand, non-conventional water resources can play a key role in the projection of future water balance at various levels (including small areas and catchments) within the context of implementation of SDG 6 targets and indicators;
- It is crucial to incorporate wastewater treatment and collection in national water development and planning. The expansion of wastewater collection networks especially in rural areas and the enhancement of treatment to levels that match end user quality demand would support a better inclusion of wastewater in the national water budgets (namely SDG 6 indicator 6.3.1: proportion of wastewater safely treated);
- The findings of this study can be used to inform operational plans in water strategy that consider SDG interlinkages. This approach will assist country planners to develop optimization methods of water allocation among the three key domains (agricultural, industrial and domestic) and to adopt water resources management tools and decision support systems that can directly inform relevant targets and indicators of SDG 6 (such as targets 6.1, 6.3, 6.4 and 6.5) For instance, RICCAR outputs illustrating near-term projections of climate indices were used to describe water availability (such as surface run-off) that can help to demonstrate freshwater resource availability over time relative to specific SDG water-use indicators (such as indicator 6.4.2 on level of water stress: freshwater withdrawal as a proportion of available freshwater resources).

Institutional Mechanisms for Monitoring the Water-related SDGs

4. Institutional Mechanisms for Monitoring the Water-related SDGs

This chapter provides insights on the institutional mechanisms for monitoring and implementing water-related SDGs on the global, regional as well as national levels. The High-level Political Forum (HLPF) and Arab Forum for Sustainable Development (AFSD) are the processes under which the progress towards the 2030 Agenda is reviewed through the Voluntary National Reviews (VNRs) and where SDG 6 was one of the goals reviewed in 2018. This chapter also maps national water sector plans and development strategies and provides country-specific case studies for linking national targets and indicators with those of water-related SDGs. Moreover, mainstreaming gender measures in water and sanitation and related goals as well as in national strategies and plans are addressed. Finally, the need for localizing water-related SDGs targets and indicators is discussed, to bring them in line with national strategies and plans in order to enable coping with water challenges in the region.

A. Global and regional processes for the implementation of SDGs

As part of the follow-up and review functions of the HLPF, member States are invited to provide a VNR report of progress achieved in implementing the 2030 Agenda. The United Nations platform is developed for monitoring and reviewing the 2030 Agenda for Sustainable Development and its 17 SDGs at the global level. The consultations undertaken during the sessions of the Forum result in the adoption of negotiated political declarations. The HLPF meets annually under the auspices of the United Nations Economic and Social Council and closes with ministerial segments. Every four years the HLPF is also convened by the United Nations General Assembly at the level of Heads of State.

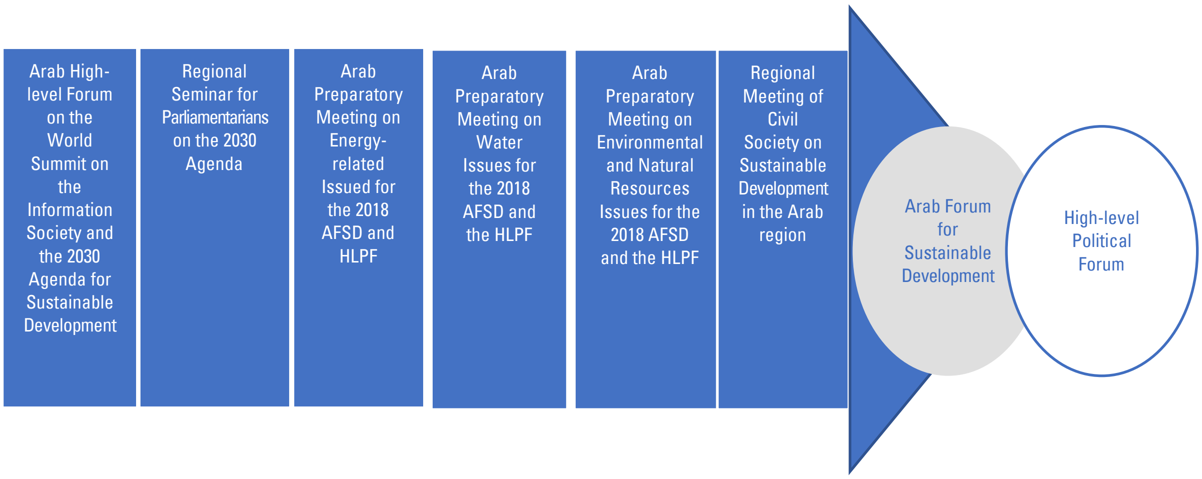
The United Nations Regional Commissions are mandated to support regional preparations for reporting and follow-up on the 2030 Agenda for Sustainable Development.[118] With their proximity to member States, they serve as intergovernmental platforms that bring together a broad range of stakeholders to promote dialogue and harness collective efforts in order to address challenges and share knowledge.[119] In addition, the regional commissions help member States translate global commitments into regional strategies and agendas by integrating sustainability and inclusivity considerations in national policies, plans and programmes as well as budgets, and by promoting the implementation of better integrated governance models.[120] As one of the five regional commissions, ESCWA is mandated to lead the implementation process of the SDGs among its member States.[121] In this context, ESCWA in partnership with the League of Arab States, annually organizes the AFSD which is the primary regional multi-stakeholder mechanism to follow up and review the implementation of the 2030 Agenda in the Arab region. The forum has been held five times since 2014, and its themes align with the respective themes of the HLPF.

The AFSD held in 2018 was focused on “Natural Resources, Future Generations and the Common Good”, which tied into the broader theme of HLPF 2018, “Transformation towards Sustainable and Resilient Societies”. The AFSD focused on national experiences in implementing the SDGs. In 2018, the focus was on SDGs 6, 7, 11, 12, 15 and 17, which were reviewed later during the HLPF 2018. Prior to the 2018 Arab Forum, and to ensure the full engagement of all stakeholders in the regional process, six regional preparatory meetings were held to prepare the inputs for the AFSD whose outcomes were submitted to the 2018 HLPF (figure 19).

These regional preparatory meetings provided the input to the AFSD to produce a report reflecting the regional position on sustainable development. This report set out key messages emanating from the regional dialogue on the opportunities and challenges of implementing the 2030 Agenda and reporting progress on key priorities on various sustainable development issues and was presented during the HLPF (box 5).

As delivered in the key messages, the AFSD emphasizes the importance of VNRs to showcase how governments of Arab States are implementing the global 2030 Agenda for Sustainable Development on the ground. VNRs are a crucial function of AFSD and HLPF as they are not merely reports, but pivotal cross-sector opportunities self-assessments of progress and sharing experiences and lessons learned on the alignment and integration of policies, measurement systems, multi-stakeholder engagement and means of implementation with the SDGs.

Figure 19. Regional preparatory meetings preceding the 2018 Arab Forum for Sustainable Development and the High-level Political Forum



Source: ESCWA, 2018c.

Box 5. Key messages of the 2018 AFSD presented during the 2018 HLPF

The final report of the 2018 AFSD included the following aspects:

- General messages;
- Arab countries' perspective on implementing and following up on the 2030 Agenda;
- Natural resources, the SDGs and future generations in the Arab context (water, sustainable energy and environment);
- Priority issues at the regional level (economic diversification; planning for resilient, inclusive and sustainable cities; financing inclusive and sustainable development; civil society's role in sustainable development, women's empowerment and mainstreaming gender equality to preserve natural resources; the principle of 'leaving no one behind' in the Arab region and localizing the SDGs); supporting regional efforts to prepare for the 2019 Arab Forum.

The following are selected key messages from the Arab perspective on implementing and following up on the 2030 Agenda:

- Formulate clear development plans based on comprehensive visions that consider interlinkages between issues, and follow a phased application process in the short, medium and long terms;
- Build institutional capacity and strengthen local governance; enhance transparency, accountability, data collection systems, information exchange and support for scientific and research institutions; promote dialogue and cooperation between sectors; and increase communication between government, financial institutions and the public and private sectors to enable effective partnerships between them;
- Affirm that data gaps, weak statistics systems and data analysis are major challenges facing Arab countries in identifying national priorities, goals and targets in line with their situations and aspirations;
- Recognize that VNRs are not only a mechanism to follow up on national development efforts, and that they entail more than the preparation of national reports. They are a catalyst for long-term participatory work, a tool to reformulate partners' roles and to identify their cooperation mechanisms and an opportunity to consider achievements, identify gaps, assess weaknesses and ensure that the development process is on the right track;
- Acknowledge that developing an approach encompassing all government sectors requires tackling disparities in understanding sustainable development plans and in interactions between different sectors and government bodies to prepare for drafting VNRs, while considering the importance of raising awareness, standardizing the development discourse and avoiding multiple coordinators of the review process at the national level.

B. National progress and status of Voluntary National Reviews

Comparing national goals and targets with the global SDGs and targets using multi-stakeholder approaches would help assess areas of compatibility or gaps at both the goal level and the target level. This multi-stakeholder approach can lead to identifying vulnerable and marginalized group that need to be engaged in the planning, implementation and monitoring processes. This will require examining all national and subnational visions and strategies such as the long-term national vision, national development plan or strategy, national strategy for sustainable development (NSDS), annual budget plans, sector strategies, subregional plans and international and regional commitments including reports submitted to global events. At the local level, there is also a need to revise municipal plans, Local Agenda 21 and community livelihood and sustainability indicators.

Since the adoption of the 2030 Agenda of Sustainable Development in September 2015, Arab countries have gradually become actively engaged in national reporting on the SDGs. During the 2018 HLPF, eight Arab countries (Bahrain, Egypt, Lebanon, State of Palestine, Qatar, Saudi Arabia, the Sudan and United Arab Emirates) submitted their voluntary national review (VNR) reports. The VNRs focused on the progress and challenges of achieving SDGs 6, 7, 11, 12, 15 and 17 in the context of each country. For the 2019 HLPF, six Arab countries presented their VNR (Algeria, Iraq, Kuwait, Mauritania, Oman and Tunisia) under the theme “Empowering people and ensuring inclusiveness and equality”, for the SDGs 4, 8, 10, 13, 16 and 17.[122] By 2019 17 out of 22 Arab countries had presented their VNR on the progress towards the 2030 Agenda.

The preparation process of VNRs requires collective national efforts and inputs from several stakeholders, covering a broad range of sectors and domains that provide integrative and comprehensive approach towards the implementation of the intrinsically linked SDGs. During the preparation of its first VNR report for the 2018 HLPF, for example, the Sudan, among other Arab countries, held consultation sessions with a wide range of Government departments and authorities, research institutions, civil society organizations and private sector stakeholders. Most of the consultative dialogue and workshops were organized by the National Population Council, which is the national SDG focal point in the Sudan as mentioned in its VNR. Such consultative sessions are important to exchange information, progress updates, challenges and achievements on the overall status of the 2030 Agenda at the national level on specific Agenda goals. Table 9 provides the specific stakeholders that were involved in the consultation on the progress on SDG 6 in the Sudan including ministries and public agencies, civil society organizations, research institutes and the private sector. This mix of stakeholders emphasizes the integrative nature of SDG 6 and that water is a cross-cutting issue among sectors and institutions.

Overview on SDG 6 reporting from selected VNRs

SDG 6 is considered uniquely central to achieving sustainable development in the Arab region. Each of the eight countries that submitted their VNRs for the 2018 HLPF had distinct experiences, situations and strategies to deal with the prevailing multifaceted water scarcity issue in the region. This overview aims to highlight some of the challenges, achievements and plans for the future regarding the implementation of SDG 6 according to the Arab VNRs that were presented. Also, it aims to test and examine how SDGs are currently reflected in the national development strategy and planning processes and to identify potential areas for change.

For instance, for the GCC countries (Bahrain, Qatar, Saudi Arabia and the United Arab Emirates) which are high income, the main priorities highlighted in their VNRs include enhancing wastewater treatment and reuse; increasing water efficiency,

Table 9. Stakeholders consulted on SDG 6 during the preparation of the Sudan's VNR for the 2018 HLPF

Government departments	Civil society organizations	Research institutions	Private sector
Federal Ministry of Environment, Natural Resources and Physical Development	Environmental Initiative for Sustainable Development (EnvI)	The Regional Centre for Water Harvesting	SWITCH for Trading and Engineering Co.
Ministry of Federal Government	The United Nations Global Compact – Sudan Network (UNGC-SN)	Water Research Centre – University of Khartoum	
Ministry of Water Resources, Irrigation and Electricity	Sudanese Consumers Protection Society (SCPS)	Individual Experts	
Ministry of Strategic Planning and Information – Khartoum State	Sudanese Environment Conservation Society (SECS)		
Ministry of Infrastructure and Transport – Khartoum State	Sudanese Civil Society Forum for SDGs		
The National Population Council	Friends of Peace and Development Organization (FPDO)		
National Council for Strategic Planning	International Charity Organization for Water		
Committee on Sustainable Development, National Assembly (parliament)	Sudanese Youth SDGs Platform		
Sudanese Standards and Metrology Organization	TUNZA Eco-generation		
Central Bureau of Statistics (CBS)	Practical Action Organization		

Source: The Sudan, Voluntary National Review 2018.

specifically in desalination processes; and improving the degree of IWRM implementation. Respectively, these priorities relate to SDG targets 6.3, 6.4 and 6.5. These countries have achieved targets 6.1 and 6.2 on access to safe drinking water and sanitation services. On the other hand, targets 6.1 and 6.2 are generally the main priorities of middle-income (Egypt, Lebanon and the State of Palestine) and low-income Arab countries (the Sudan) and yet to be achieved for 100 per cent of the population.

Other priorities including water pollution, wastewater treatment, water efficiency and IWRM are also addressed by Arab middle-income countries, such as Egypt. As mentioned in its VNR, the Egyptian Government has been tackling the issue of water pollution in the Nile River by moving from traditional techniques to advanced technological solutions. Twenty-two advanced monitoring stations, which are expected to increase to 95 stations by 2030, have been installed to monitor the quality of the river and the quality of industrial discharge into the river.[123] In terms of technology, it is evident from their VNR reports that the high-income Arab countries are highly focused on promoting scientific research and technological innovations to overcome water scarcity challenges. As one of the largest producers of desalinated water in the world, Saudi Arabia has established a specialized research institute to conduct research studies in the field of seawater desalination. The research institute was established by the Saline Water Conversion Corporation (SWCC) and is located next to one of the largest desalinations and power generation plants in the eastern region of the country where it has been contributing to improvements in desalination technology, water treatment, efficiency and decreasing production costs.[124]

Box 6. Challenges affecting clean water and sanitation access in Lebanon

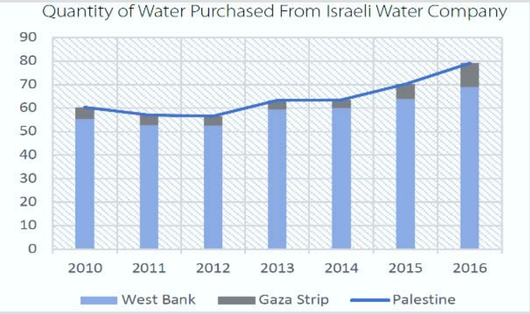
Despite its geographic location in one of the most water-scarce regions in the world, Lebanon has sufficient natural water resources. Yet the country still faces complex water challenges due to uncontrolled consumption and increased pollution. The national water distribution network provides nearly full coverage of Lebanon while the wastewater network does not fully cover the country with regional differences. Access to safe drinking water and sanitation services reaches only 37 per cent and 20 per cent of the population, respectively. On one hand, there are deficiencies in water supply and contamination across the distribution network, as well as unsustainable water extraction practices and uses. On the other hand, there are institutional and financial challenges facing the operation and maintenance of existing wastewater networks and treatment plants. These challenges have been also exacerbated by the sudden influx of refugees that has put further stress on the system and services.

Source: Lebanon, 2018. Voluntary National Review of Sustainable Development.

Ultimately, each Arab country or each group of countries is approaching SDG 6 in a distinct manner, suiting the specific needs, priorities and capabilities. A general observation from the VNR reports on SDG 6 is that the countries’ efforts have been diverted from the mere provision of such services towards their management and sustainable use of water resources, which incorporates the other targets of SDG 6 such as water efficiency, IWRM and environmental protection. Moreover, the Arab countries are becoming more conscious of the SDGs interlinkages which are cross-cutting through national development plans and programmes. The major interlinkages addressed in the Arab VNR reports are the water-food-energy nexus (as stated by Bahrain, Lebanon and the Sudan) in addition to the water-climate/energy-climate nexus that has been gaining significant attention in the Arab region. On the other hand, some VNRs illustrated how SDG 6 interlinks with a country's national water policies and strategies (Saudi Arabia) and how SDG 6 and other SDGs can be integrated in the action plans of those strategies. For instance, Bahrain's Information and eGovernment Authority (IGA) has integrated 78 per cent of the SDGs indicators to the programmes and plans of its National Agenda for 2015-2018, which has been found to be an efficient way to monitor global indicators in the national context.

Box 7. Challenges affecting access to water resources in the State of Palestine

The occupation of the State of Palestine has resulted in unequal and widening gap in the availability of water between Palestinians and Israelis. Palestinians are allocated only 13 per cent of the water from the shared Mountain Aquifer compared to 87 per cent share for Israel, despite the fact that 85 per cent of water refilling the aquifer occurs within the State of Palestine. These restrictions have forced the Palestinian government to purchase water from the Israeli national water carrier, which increases dependence on external water sources and the financial burden of meeting the water needs of the Palestinian population in the West Bank and Gaza Strip.



Source: State of Palestine, Palestinian National Voluntary Review on the Implementation of the 2030 Agenda, 2018.

Box 8. Water innovation in the United Arab Emirates

Water, as one of the key seven pillars of the United Arab Emirates' National Innovation Strategy, is a priority issue in the country. As part of the strategy, the country aims to be a global leader in rain enhancement science and technology. The United Arab Emirates Research Program for Rain Enhancement Science aims to advance the scientific and technological base of rain enhancement, using technology to stimulate and increase rainfall. Offering grant funding of $5 million annually, the programme has attracted growing interest from researchers around the world.

Source: United Arab Emirates National Committee on Sustainable Development Goals, Voluntary National Review, 2017.

C. National Strategies for Sustainable Development

One of the key messages that was highlighted earlier in this chapter from the 2018 AFSD report is that Arab countries need to develop integrative and comprehensive development visions and strategies that engage all stakeholders and cover all sectors. The sustainable development goals as set out by the 2030 agenda for sustainable development provide an important tool to frame and support the integration of sectoral development goals at country level across the Arab region.

In order to examine how Arab States are addressing these intersectoral issues, a mapping of national development strategies and water plans has been carried out to show the centrality of water in sustainable development in the region. Table 10 provides a list of visions and plans that are in place which are expected to lead the implementation integrated water resources management and achieving sustainable development at the national level. The next section will provide specific examples from selected national strategies/plans.

Table 10. Mapping of national development plans and water strategies in selected countries for the Arab region

Country	Development plan	Water strategy/plan
Algeria	Algeria Vision 2035	National Biodiversity Strategy and Action Plan 2016-2030
Bahrain[a]	Bahrain Economic Vision 2030	National Biodiversity Strategy and Action Plan (2016-2021)
Egypt	Egypt Vision 2030	National Water Resources Plan for Egypt 2017-2037
		Environment Pillar in Vision 2030 strategy addressing water
		National Water Resources Plan 2005-2017
Iraq	Iraq Vision 2030	The National Environmental Strategy and Action Plan for Iraq (2013-2017)
	National Development Plan (2018-2022)	
Jordan	Jordan Vision 2025	Water for Life, Jordan's Water Strategy 2008-2022
		National Water Strategy (2016-2025)
	Jordan Economic Growth Plan (2018-2022)	Ministry of Environment Strategic Plan (2017-2019): Vision of 2025: Foreseeing the Future
Kuwait	Kuwait National Development Plan 2035	National Biodiversity Strategy and Action Plan 2011-2020
Lebanon	Economic and Social Reform Action Plan 2012-2015	National Water Sector Strategy
Libya	Libya Vision 2020	
Mauritania	Agenda Post-2015	National Environment Plan 2012-2016
		National Sanitation Development Plan 2012-2020
		National Strategy for Environment and Sustainable Development and Action Plan for 2017-2021

Country	Development plan	Water strategy/plan
Morocco	National Strategy for Sustainable Development 2030	National Water Strategy (2010-2030)
Oman	Oman Vision 2016-2020	Oman National Water Resource Management Master Plan (2001-2020)
	Oman Vision 2040 (forthcoming)	
State of Palestine	National Development Plan 2014-2016	National Water Sector Strategic Plan and Action Plan (2017-2022)
Qatar	Qatar National Vision 2030	
	Qatar National Development Strategy 2011-2016	
	National Development Strategy 2011-2016	
Saudi Arabia	Saudi Arabia Vision 2030	National Water Strategy 2025
The Sudan	National Strategy for Sudan 2007-2031	Water, Sanitation and Hygiene Sector National Strategic Plan (2012-2016)
Syrian Arab Republic	Syrian Arab Republic Interim Country Strategic Plan (2019-2020)	
Tunisia	Strategic Orientation Note on the plan of future development 2016-2020	2050 Water Vision and Strategy (forthcoming)
United Arab Emirates	United Arab Emirates Vision 2021	Water Security Strategy 2036
Yemen	Yemen Strategic Vision 2025	National Water Sector Strategy and Investment Program (2004)
		National Environment Strategy 2012-2025
		National Biodiversity Strategy and Action Plan II: "Achieving a resilient, productive and sustainable socio-ecosystem by 2050"

[a] Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates have the GCC Unified Water Strategy (2016-2035).

D. Water-related measures in national water strategies and sustainable development visions

1. Case study of Egypt

The Ministry of Water Resources and Irrigation (MWRI) has developed a new National Water Resources Plan (NWRP 2017-2037) to mitigate Egypt’s water scarcity issues and improve the performance of the water sector. The forthcoming NWRP is a 20-year plan that is being developed through a four-pillar approach involving nine ministries[125] and various international partners to insure integration between all sector policies at the national level. It builds upon the previous NWRP (2005-2017) and it aligns its ambitions to the “Sustainable Development Strategy (SDS): Egypt’s Vision 203”’. The Vision tackles water issues under its ninth pillar related to the environment. The Vision focuses on water resources and achieving water security given the critical impact of this issue on national security as Egypt has entered the water scarcity phase, along with the impacts of climate change and the expected increase in population, which will result in increasing demand with fixed available water resources. In response to the various challenges of the water sector, the following represents the key programmes and projects to implement the Sustainable Development Strategy (SDS) of Egypt’s vision during 2016-2030:

- Strengthen the institutional and legislative structure of the water resources management system;
- Expand the establishment and development of required infrastructure for achieving a sustainable water system;
- Implement financial policy reforms and use of economic instruments to move toward more sustainable consumption patterns of water and natural resources;
- Increase awareness of the need to preserve the environment and natural resources, motivating required alternatives and technologies for water rationalization, and protecting natural resources;
- Enhance the efficiency of protecting coastal and marine areas;
- Establish a higher council for sustainable development.

Each of the above programmes/projects is described with its key elements in the SDS under the environmental dimension.[126] Moreover, the SDS provides a set of environmental indicators including water-specific indicators along with targets for the years 2020 and 2030 (table 11).

Clear targets and indicators are important for assessing a country’s progress on national goals as well as global goals such as the SDGs. Sometimes the SDG targets are broad and generic, which is intentional as the 2030 Agenda aims to accommodate the different needs of countries, yet national targets and indicators remain a priority. In such case, countries can be guided by global targets and indicators to meet their own national goals. For example, Egypt indicated in its VNR for the 2018 HLPF that out of the 11 global indicators on SDG 6, four indicators are available on the national level and seven are not available and/or no sufficient national data are available to generate the indicator.

Thus, the table 11 aims to showcase the potential interlinkages between Egypt’s national water and environmental targets and indicators in its Sustainable Development Strategy (SDS) and that of SDG 6. It can be seen in the table that the sector monitoring indicators are adequately linked to the SDG targets and indicators for the water sector. Egypt's SDS has an environmental dimension that includes water-related indicators and the potential numeric targets for 2020 and 2030. Generally, most of Egypt's national water indicators relate to SDG 6 indicators on water quality, wastewater treatment and water efficiency, which reflect the country's priorities. Moreover, several national indicators could be linked to the SDG 6 indicators as some countries have well-developed performance indicators as well as monitoring and evaluation tools to assess national water resources status. For instance, national indicators such as ratio of total water consumption, percentage of loss in water treatment plants and percentage of loss in water transfer networks can be linked to SDG 6 indicator on water-use efficiency. They might not produce the official SDG indicator, but they can be considered as proxy/alternative or complementary national indicators for reporting on the global indicator. On the other hand, the SDG indicator can be recommended for adoption as a new national indicator if it is assessed to be of high relevance and importance in the national context.

Table 11. Egypt's national water sector indicators and targets for 2020 and 2030 in comparison with targets and indicators of SDG 6

#	National indicator	Source of national indicator	Current status	Source of data	2020 national target	2030 national target	Potential link to SDG 6 target	Potential link to SDG 6 indicator
1	Ratio of total water consumption (per cent)	Sustainable Development Strategy: Egypt Vision 2030 (Environment Dimension)	107 per cent	Central Agency for Public Mobilization and Statistics (CAPMAS), Egypt, Statistics of the Year 2015	100 per cent	80 per cent	6.4 – Water-use efficiency and scarcity	6.4.2 – Level of water stress: freshwater withdrawal as a proportion of available freshwater resources
2	Fresh water resources per capita (renewable)	Sustainable Development Strategy: Egypt Vision 2030 (Environment Dimension)	650 m^3/year	Ministry of Water Resources and Irrigation, 2015	750 m^3/year		6.4 – Water-use efficiency and scarcity	6.4.2 – Level of water stress: freshwater withdrawal as a proportion of available freshwater resources

#	National indicator	Source of national indicator	Current status	Source of data	2020 national target	2030 national target	Potential link to SDG 6 target	Potential link to SDG 6 indicator
3	Ratio of non-conventional water resources to total water resources usage	Sustainable Development Strategy: Egypt Vision 2030 (Environment Dimension)	20 per cent	Central Agency for Public Mobilization and Statistics (CAPMAS), Egypt, Statistics of the Year 2015	30 per cent	40 per cent	6.4 – Water-use efficiency and scarcity	6.4.2 – Level of water stress: freshwater withdrawal as a proportion of available freshwater resources
4	Sanitation as percentage of total sewage (per cent)	Sustainable Development Strategy: Egypt Vision 2030 (Environment Dimension)	50 per cent	Environmental Performance Index Report, 2014	60 per cent	80 per cent	6.3 – Water quality and wastewater	6.3.1 – Proportion of wastewater safely treated
5	Illegal industrial sewage into the Nile River as a percentage of the total industrial sewage (per cent)	Sustainable Development Strategy: Egypt Vision 2030 (Environment Dimension)	21 per cent	Egyptian Environmental Affairs Agency (EEAA), 2015	16 per cent	0 per cent	6.3 – Water quality and wastewater	6.3.2 – Proportion of bodies of water with good ambient water quality
6	Sanitation percentage according to the national standards, disposed in the Nile River (per cent)	Sustainable Development Strategy: Egypt Vision 2030 (Environment Dimension)	50 per cent	Egyptian Environmental Affairs Agency (EEAA), 2015	70 per cent	100 per cent	6.3 – Water quality and wastewater	6.3.1 – Proportion of wastewater safely treated
7	Percentage of loss in water transfer networks (per cent)	Sustainable Development Strategy: Egypt Vision 2030 (Environment Dimension)	15 per cent	Ministry of Housing, Utilities and Urban Development 2015	Less than 10 per cent	Less than 5 per cent	6.4 – Water-use efficiency and scarcity	6.4.1 – Change in water-use efficiency over time
8	Percentage of loss in water treatment plants (per cent)	Sustainable Development Strategy: Egypt Vision 2030 (Environment Dimension)	30 per cent	Ministry of Housing, Utilities and Urban Development 2015	Less than 20 per cent	Less than 10 per cent	6.4 – Water-use efficiency and scarcity	6.4.1 – Change in water-use efficiency over time

#	National indicator	Source of national indicator	Current status	Source of data	2020 national target	2030 national target	Potential link to SDG 6 target	Potential link to SDG 6 indicator
9	Composite biodiversity and environment indicator of 3 subindicators: (1) the area of nature reserves/total area of land and watercourses, (2) area of marine and coastal natural reserves/marine and coastal total area, (3) ratio of protected sites classified as AZE[a] to total sites classified	Sustainable Development Strategy: Egypt Vision 2030 (Environment Dimension)	Not specified (N/S)	N/S	N/S	N/S	6.6 – Water-related ecosystems	6.6.1 – Change in the extent of water-related ecosystems over time

Source: Egypt, Sustainable Development Strategy (SDS): Egypt's Vision 2030.
[a] AZE is the Alliance for Zero Extinction sites. See http://www.biodiversitya-z.org/content/alliance-for-zero-extinction-sites-aze.

2. Case study of Jordan

The Jordanian National Water Strategy (2016-2025) represents the vision of the water sector and is the base for the related policies and programmes, including:

- Water Sector Capital Investment Plan 2016-2025;
- Water Demand Management Policy;
- Energy Efficiency and Renewable Energy in the Water Sector Policy;
- Water Substitution and Reuse Policy;
- Water Reallocation Policy;
- Surface Water Utilization Policy;
- Groundwater Sustainability Policy;
- Climate Change Policy for a Resilient Water Sector;
- Decentralized Wastewater Management Policy;
- Action Plan to Reduce Water Sector Losses (structural benchmark).

With respect to the alignment of the national water indicators and SDG 6 indicators, it should be noted that assessing the success of a certain policy or measure requires monitoring through performance indicators. Table 12 provides a set of national indicators developed by the Ministry of Water and Irrigation (MWI) for the National Water Strategy (2016-2025) to assess the progress towards a set of goals for the water sector in Jordan. These national indicators were analysed to examine the linkages with SDG 6 targets and indicators in an attempt to examine the integration between national and global water-related targets in order to assist the countries to develop one track for monitoring their national policies in agreement with monitoring and reporting SDG 6 targets and indicators. Generally, selected indicators are mostly related to the SDG 6 indicators on drinking water, sanitation and water efficiency. Notably, the last indicator in the table that measures energy consumption for water production confirms that the country is primarily focusing on meeting efficiently water demands in a context of water-energy nexus.

It is also evident that IWRM is an important dimension of the latest National Water Strategy (2016-2025), but the strategy does not include specific indicators to measure IWRM. Thus, the indicators 6.5.1 (degree of integrated water resources management implementation) and 6.5.2 (proportion of transboundary basin area with an operational arrangement for water cooperation) can be adopted as national indicators given the fact that Jordan has reported progress made on these two indicators 6.5.1 and 6.5.2 in its Voluntary National Review (VNR) report in 2017. In addition, although the country has informed the progress made on the indicator 6.6.1 (change in the extent of water-related ecosystems over time), the National Water Strategy (2016-2025) needs to incorporate a specific national indicator on this front (table 12). Connected to this, indicator 6.6.1 can be adopted as a national indicator given that the protection of “aquatic ecosystems” and “water-dependent ecosystems” were considered as key principles to guide future water sector planning in Jordan.[127] Overall, this can also assist Jordan in its national monitoring of implementation of IWRM and water-related ecosystems in conjunction with the process of reporting on SDG 6 as a whole.

In Jordan, water for irrigation, energy and other uses will be guided by the Water Reallocation Policy which will inform the redistribution of water between sectors and governorates.[128] Regarding water for irrigation, the MWI aims to substitute treated domestic wastewater in place of fresh water for irrigated agriculture. Other options for improving irrigated agriculture include:

- Reducing inefficient agricultural practices (for example, by shifting to more water-efficient crops to optimize yield per cubic meter of water used);
- Increasing water supply for agriculture (such as through diversification of sources of water used in irrigation);
- Introducing appropriate water service cost and incentives (for example, Ministry of Agriculture/MWI to discourage planting crops with high water requirements using market related instruments such as by imposing higher water tariffs on irrigated agriculture in areas where highly water-intensive crops are being grown);
- Establishing a comprehensive risk management system (mainly to ensure the health of agricultural labourers, the productivity of the soil and hygienically safe produce).

Regarding energy in the water sector, the “Energy Efficiency and Renewable Energy in the water Sector Policy” focuses on reducing the energy consumption of billed water and increasing the share of renewable energy resources in power generation for the water sector according to the following targets: achieving a 15 per cent reduction in the specific energy consumption of billed water corresponding to a 0.46 kg reduction of CO_2 emissions for the production of each billed cubic metre of water; adding a 10 per cent increase in the share of renewable energy resources in power generation for the sector, corresponding to a total saving of 0.26 kg of CO_2 emissions per each billed cubic meter of water. By doing so, Jordan would aim to have 20 per cent of the electricity consumed in the water sector generated from renewable energy sources by 2021.[129] The MWI is implementing five mega-renewable energy projects, mainly solar and wind sources, to achieve this goal.

Table 12. Jordan's national water sector indicators and targets 2025 in comparison with targets and indicators of SDG 6

#	National indicator	National goal	Source of national indicator	2014 national baseline	2025 national target	Potential link to SDG 6 target	Potential link to SDG 6 indicator
1	Percentage of water service coverage	Enhance the services of water and wastewater	National Water Strategy 2016-2025	94 per cent	95 per cent	Target 6.1 – Drinking water	6.1.1 Proportion of population using safely managed drinking water services
2	Percentage of wastewater service coverage		National Water Strategy 2016-2025	63 per cent	80 per cent	Target 6.2 – Sanitation and hygiene Target 6.3 – Water quality and wastewater	6.2.1 Proportion of population using safely managed sanitation services, including a handwashing facility with soap and water 6.3.1 Proportion of wastewater safely treated
3	Water share per capita (L/C/D)	Supply of water to meet the demand for all uses	National Water Strategy 2016-2025	61	105	Target 6.1 – Drinking water Target 6.2 – Sanitation and hygiene	6.1.1 Proportion of population using safely managed drinking water services 6.2.1 Proportion of population using safely managed sanitation services, including a handwashing facility with soap and water
4	Available water resources (m^3/year)		National Water Strategy 2016-2025	832	1341	Target 6.4 – Water-use efficiency and scarcity	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources

#	National indicator	National goal	Source of national indicator	2014 national baseline	2025 national target	Potential link to SDG 6 target	Potential link to SDG 6 indicator
5	Water share for all uses (m^3/year)		National Water Strategy 2016-2025	90	114	Target 6.4 – Water-use efficiency and scarcity	6.4.1 Change in water-use efficiency over time
6	Dam storage capacity		National Water Strategy 2016-2025	325	400	Target 6.4 – Water-use efficiency and scarcity	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources
7	NRW (non-revenue water)	Water resources sustainability and protection	National Water Strategy 2016-2025	52 per cent	30 per cent	Target 6.4 – Water-use efficiency and scarcity	6.4.1 Change in water-use efficiency over time
8	Percentage of over abstraction		National Water Strategy 2016-2025	160 per cent	140 per cent	Target 6.4 – Water-use efficiency and scarcity	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources
9	Percentage of protected resources		National Water Strategy 2016-2025	35 per cent	60 per cent	Target 6.3 – Water quality and wastewater	6.3.2 Proportion of bodies of water with good ambient water quality
10	Percentage of operation and maintenance coverage	Financial sustainability	National Water Strategy 2016-2025	70 per cent	127 per cent	Target 6.4 – Water-use efficiency and scarcity	6.4.1 Change in water-use efficiency over time
11	Government support (million JOD)		National Water Strategy 2016-2025	170	180	6.b Support and strengthen the participation of local communities in improving water and sanitation management	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

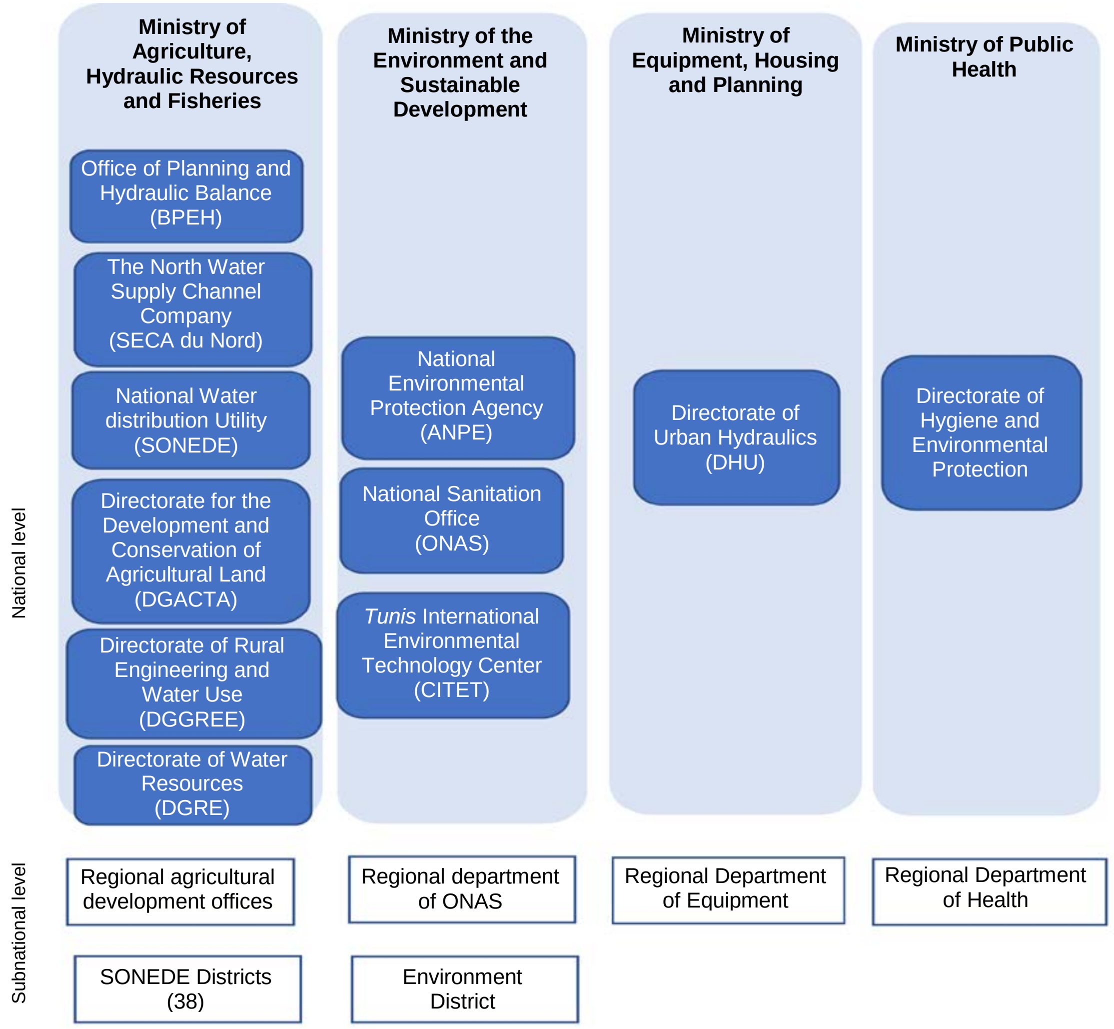
#	National indicator	National goal	Source of national indicator	2014 national baseline	2025 national target	Potential link to SDG 6 target	Potential link to SDG 6 indicator
12	Net debt (million JOD)		National Water Strategy 2016-2025	1170	1200	6.a By 2030, expand international cooperation and capacity-building 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.a.1 Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan
13	Energy used per m^3 billed (kwh/m^3/billed)		National Water Strategy 2016-2025	4.31	3.66	SDG 7 (Water-Energy Nexus) may be targets 7.2 "by 2030 increase substantially the share of renewable energy in the global energy mix" and 7.3 "by 2030, double the global rate of improvement in energy efficiency" and may be target 6.4-water-use efficiency and scarcity	7.2.1 – Renewable energy share in the total final energy consumption 73.1-Enrgy intensity measured in terms of primary energy and GDP 6.4.1 Change in water-use efficiency over time

Source: Jordan's Ministry of Water and Irrigation, National Water Strategy, 2016-2025.

E. Institutional interlinkages: the case of Tunisia

Adapting the water-related SDGs to national contexts is fundamentally a complex and non-conventional task and therefore would require multi-stakeholder engagement in the process. At the same time, the water-related SDGs can encourage different sectors/stakeholders to monitor their linkages and policy coherence with the national priority areas. It is thus essential to create a common understanding among all stakeholders of how well existing national and subnational development plans and sectoral strategies align.

Figure 20. Major national and subnational institutional stakeholders in the Tunisian water sector



This will help in establishing criteria for enhancing the implementation of national plans and monitoring across concerned sectors and actors. Prior to that, it is essential to examine existing interlinkages across water-related institutions on the national and subnational levels in order to determine the actions and measures needed to enhance the multi-stakeholder approach for policy coherence. For example, the water sector in Tunisia, and similarly in many other Arab countries, involves several ministries and subordinates both at the national and subnational levels as shown in figure 20.

In the previous section, the key ministry in Jordan and Egypt was the Ministry of Water and Irrigation, while in the case of Tunisia, it is the Ministry of Agriculture, Hydraulic Resources and Fisheries, which reflects different national needs in relation to water-related interlinkages. This structure of the Tunisian key stakeholders in the water sector shows that water issues involve several ministries and departments under each ministry which also branch out to subnational institutional stakeholders. There are also other ministries that play an important role in the water sector in Tunisia, such as the Ministry of Commerce which is responsible for monitoring and evaluating the exports and imports of virtual water of agricultural products.[130] In addition, the Ministry of Finance plays a critical role in planning and budget allocation of water projects. With respect to legal reforms, Tunisia has also approved several articles and decrees in recent years related to water and sanitation services to support its institutional setup and functions including the following:

- Article 44 of the Tunisian Constitution, approved in 2014, states that: “The right to water shall be guaranteed. The conservation and rational use of water is a duty of the state and of society”;
- The Water Code officially released in 1975 has been amended many times. In 2014, the Ministry of Agriculture, Hydraulic Resources and Fisheries submitted a draft Water Code to the Presidency of the Tunisian Government which was approved in 2016;
- Decision of the Minister of Economy and Finance and the Minister of Equipment, Sustainable Development and Regional Planning of January 2015, establishing the amount for sanitation fees.

The outcome of a study prepared by the Sahara and Sahel Observatory on a “Development of a vision and strategy for water in Tunisia by 2050”[131] is expected to inform national reform of the water sector. In October 2018, a working session was convened and attended by experts in the water sector, agriculture, fisheries, environment and local development.[132] The overall objective of the project is to contribute to socioeconomic development, securing the availability and access to water resources for Tunisia by 2050 efficiently, equitably and sustainably.[133]

Tunisia was also selected among five pilot countries to receive support under the SDG Policy Support System (SDG-PSS).[134] The aim of this system is to allow governments to measure and report on the progress of six critical policy components for achieving SDG 6: capacity, finance, policy/institutions, gender, disaster risk reduction (DRR)/resilience and integrity in order to ultimately advance the progress towards the water-related SDGs.[135] According to the preliminary results of the application of the SDG-PSS, the country is performing best in the policy/institutions component of SDG 6. On the other hand, the country is progressing least in the capacity and finance components has not shown any evidence in the governance-related to gender mainstreaming aspects. Most of the identified gaps are attributed to the lack of data (availability and reliability) and especially disaggregated data to run information systems.[136] A regional workshop was held in July 2019 in Tunisia for further training on the application of the different components of SDG-PSS in relation to SDG 6. Thus, as Tunisia applies the SDG-PSS, it will be able to identify the strengths and weaknesses in its water sector, and thereby invest its resources in accordance with its national priorities.

F. Mainstreaming gender in National Water Strategies and Programmes

Many Arab countries have acknowledged the importance of gender issues in the water sector, and with the current international support for gender mainstreaming, countries are encouraged to implement strategies to move towards gender equality and women empowerment in the water sector. The process of gender mainstreaming in national water policy starts at identifying and assessing gender gaps and needs in the water sector.

Box 9. Women in the Egyptian water sector

Women's engagement in the decision-making process is one aspect of mainstreaming gender in the water sector. In Egypt women hold many important positions in the Ministry of Water Resources and Irrigation (MWRI). Moreover, a gender equity unit was established in MWRI according to a 2002 ministerial decree to mainstream gender concerns at the ministry and community levels. The unit conducted several trainings for both women and men related to mainstreaming gender in the Ministry's activities, disseminated public information and messages about gender and gathered data from the field to analyse and monitor gender issues in the water sector.

Regarding women's engagement in water management on the local level, the Water Users' Associations (WUAs), which were first established in the late 1990s, aimed to develop a participatory approach to irrigation management. A WUA is made up of a group of farmers who utilize a common source of water and thereby have direct contact and consultation with MWRI officials and district engineers to manage the water resource. Due to the cultural barriers towards accepting women's participation in the WUA, a female quota was assigned by the MWRI to reserve two seats for female members. However, the female members did not receive proper capacity-building trainings and did not have active roles in decision-making. As a consequence, the quotas were removed and female members were elected through the same mechanism as men.

WUAs are fully or partially established and active in the Governorate of Fayoum and in the Nile Delta. Fayoum is the only Governorate that has full coverage with WUAs and more active female participation compared to other regions, yet female members mainly represented as residential water users and to lesser extent agriculture water users, despite their significant involvement in irrigation activities. As women received awareness-raising sessions and capacity-building workshops, they became more knowledgeable about water management which enhanced their roles in the WUA. Nonetheless, further capacity-building activities are needed in order to practically tackle gender issues in local rural communities.

It can be concluded that the MWRI is well aware of the importance of gender mainstreaming in the management of the public water sector, yet the mechanisms employed have not been fully successful tackling the different aspects of gender issues in the institutional context and the local level.

Source: UNESCO, 2015.

The identified gaps and needs should be addressed in the planning and development phase of national water strategies which set the programmes and/or actions required in order to meet those needs and resolve the gaps through effective monitoring and evaluation. The gender needs and gaps in the Arab region are mainly related to women's and girls' roles in the water sector as was discussed in chapter 2. However, the needs and gaps vary among countries and from one local context to another, especially in the conditions of countries hosting refugees and internally displaced people. For many Arab countries as well, the active participation of women in irrigation activities is a priority to be addressed in the area of water management. The percentage of female agriculture workforce is very high in several Arab countries like Egypt, Djibouti, Somalia and Morocco where 49 per cent of the population active in the Moroccan agriculture sector are females.[137] Within the institutional context, box 9 and box 10 present examples of women's engagement in decision-making in the water sector in Egypt and the State of Palestine, respectively, along with measures undertaken in each country in response to gender mainstreaming in national water policy, with the further elaboration of the Palestinian policy on gender provided in table 13.

Box 10. Women in the Palestinian water sector

In the State of Palestine, women face many challenges in participating in water governance issues due to the patriarchal society and the special context of water resources being completely controlled under the Israeli occupation. On an institutional level, the involvement of Palestinian women in the environment sector, specifically in the water and waste management sectors, is very limited: women's representation does not exceed 8 per cent in service provision utilities and 32 per cent in the ministries and the authorities of these sectors. On the other hand, women have a central role in water management and hygiene on the household level, and they are also responsible for major farming activities in rural areas. Moreover, as women and girls are usually responsible for water collection and transportation, they are more vulnerable to violence and humiliation under occupation.

The State of Palestine has been aware that women need to be further integrated in the environment sector and that their roles should be strengthened on the policy, professional and community levels. In this context, the "Gender Strategy for the Environment Sector with emphasis on water and solid waste" was developed in 2012 for the period 2013-2017. The strategy was prepared by a national team comprised of a range of concerned institutions and organizations including the Palestinian Water Authority, Ministry of Local Government, Ministry of Women's Affairs, Ministry of National Economy, National Team for Waste Management in addition to environmental NGOs, academic institutions and environmental consultants. It comprises nine strategic goals with their corresponding policies and interventions needed under three main areas, namely gender mainstreaming policies, institutional capacity-building for women and women's community participation.

In order to monitor the implementation of the set goals, each strategic goal is measured by specific indicator/s, and similarly for each policy and intervention respectively; i.e. there are three sets of indicators to follow up on each of the nine strategic goals, as shown in table 13 for gender mainstreaming policies in water and waste management sectors. Thus, this national strategy proves the efforts that have been exerted in countries of the region to move towards gender mainstreaming in national policy in order to leave no one behind.

Source: Palestinian Water Authority, 2015; State of Palestine, 2012.

Table 13. Key elements of the "Gender Strategy in the Environment Sector-focus on water and solid waste" of the State of Palestine

Strategic Goal	Indicators
Goal 2: Monitoring system and effective evaluation to ensure the implementation of gender-responsive policies	• At least 30 per cent of the institutions in both sectors applied strategies and plans responsive to gender issues.
Policy	**Indicators**
Activate monitoring of the implementation of gender-responsive plans, strategies and policies	• At least 30 per cent of institutions in both sectors use monitoring and evaluation mechanisms for plans and strategies involving gender issues; • At least 30 per cent of institutions in both sectors apply control and complaints system responsive to gender issues.
Interventions	**Indicators**
Activating policies and mechanisms for monitoring and evaluating the implementation of gender-related plans, strategies and policies	• 50 per cent of institutions in both sectors have follow-up and evaluation mechanisms for the implementation of plans and strategies; • Follow-up and evaluation guide for the implementation of gender-related policies, plans and strategies.
Activation of internal control in institutions in response to mainstreaming gender issues	• At least 50 per cent of the institutions in both sectors have control bodies using indicators to ensure gender responsiveness.
Activating gender-sensitive control and guidance by external oversight bodies (Local Government control, Water Authority and Diwan Administrative and Financial Control)	• 5-10 codes of conduct and agreements to ensure observance of gender issues; • Gender-responsive external control systems; • 80 per cent of oversight measures involves gender mainstreaming.
Activation of complaint units and mechanisms (there is a decision Council of Ministers to form public complaint units)	• At least 80 per cent of the institutions in both sectors have internal complaints units; • Complaint procedures manual responsive to gender; • Minimum of 5 different complaint tools; • At least 50 per cent staff from relevant institutions are qualified to deal with gender-related complaints.

Source: State of Palestine, 2012.

Means of Implementation and Recommendations

5. Means of Implementation and Recommendations

There is a need for effective institutions to build on the linkages between different sectors to achieve water security and the water-related goals and targets through a multi-stakeholder approach. Also, effective actions need to be taken at different levels of intervention to enhance existing institutional and implementation mechanisms and develop innovative solutions to achieve water-related goals and targets based on regional, national and local circumstances. Therefore, an efficient framework will enable all actors to be involved in dealing with water-related SDGs and in implementing national policies and action plans. Clear principles, guidelines and learning from past failures and success stories need to be incorporated in this framework. Adjusting institutional mandates or policies to reflect the interrelationships between different institutional stakeholders will be an important concrete step towards defining positive synergies between various responsible actors and minimize trade-offs. This chapter concludes with a suggested framework to enhance reporting, monitoring and implementation of water-related goals through water accounting for sustainable development. Moreover, a set of recommendations is suggested for prioritizing water-related SDGs, targets and indicators to bring them in line with national strategies and plans to cope with water challenges in the region within the context of implementation and monitoring of the 2030 Agenda.

A. Adapting SDG implementation to national context and local conditions

As emphasized throughout this report, SDG 6 is central for sustainable development in the Arab region as water issues cross-cut through all sectors and are explicitly or implicitly linked to all SDGs. Countries are in fact aware of such interlinkages between the water sector and other sectors; specifically, agriculture, energy, environment and climate change which requires integrated policies and strategies to be addressed such interlinkages (such as the water-food-energy nexus).

Adapting the SDGs to national contexts essentially involves countries setting their own targets in view of the level of ambition of the global SDGs and targets and taking into account national circumstances. This is primarily why this report focuses on country-specific case studies in order to highlight national specificities of water issues in the water-scarce Arab region. Developing guidelines and sharing lessons learned and knowledge can assist the Arab countries in doing so. However, baseline data for several of the targets are unavailable, and therefore, there have been many calls for increased support for strengthening data collection and capacity-building to develop national and global baselines that can be used in monitoring the implementation of the SDG targets and indicators along with the short and mid-term plans evaluation (for example, to develop five-year plans till 2030).

Countries will need to adapt new means of implementation to support the updating of their national sustainable development strategies to revise existing goals and targets and adapt them to help deliver the SDGs nationally and globally with one reporting track and monitoring system. This will require incorporating SDG indicators into existing reporting frameworks and progressively adapting their reporting systems to be consistent with the 2030 Agenda's targets and indicators through the revision of short- and medium-term sector and development plans.

As many SDG indicators are still missing at the national and subregional levels, governments should work collaboratively with regional organizations on strengthening statistical capacities of various institutions for monitoring progress and evaluating sector-based impacts and to ensure linkages between the sector’s statistical and planning units and the central statistical agency which usually acts as the official focal point for communicating country-wide statistical information to regional and global platforms.

B. Developing a framework for implementing water policies within the context of monitoring and reporting on the water-related SDGs

1. Sustainable development monitoring and reporting

Sustainable development calls for a long-term vision for society, economy and environment, which in return requires long-term instruments for monitoring progress towards long-term objectives. This is challenging in a political context where policymakers are operating on shorter time horizons that seek immediate impacts and benefits for existing constituencies. Policymakers thus need to consider the impact of their policies and decisions beyond the near term and to weigh trade-offs between the three dimensions of sustainable development over time in order to reach “win-win” policies.

Over the past two decades prior to the endorsement of the 2030 Agenda, there have been increasing international and national interests in accounting research to measure sustainable development as a way to coordinate and monitor policies and targets on the national, regional and global levels.[138]
In 2012, the United Nations Statistical Commission adopted the System of Environmental-Economic Accounts (SEEA) as a measurement framework in support of sustainable development and green economy policy.[139] The SEEA constitutes three subsystems; SEEA-Water, SEEA-Energy and SEEA-Agriculture,[140] where each subsystem includes agreed concepts, definitions, classifications, tables and accounts for the corresponding sector that ultimately supports policy needs through an integrative approach. In the case of the European Union for example, which is a leader in environmental accounting, SEEAs have been further developed and promoted in the European Strategy for Environmental Accounts 2019-2023.[141] This initiative aims to enhance monitoring European progress towards the SDGs and to contribute to policy and decision-making. Such an accounting framework is very important especially for the Arab region where many countries struggle with generating reliable and high-quality accounts that integrate all the dimensions of sustainable development.

However, developing a whole accounting system for sustainable development at once is mostly impossible and very exhaustive for many of the Arab countries. Since the SEEA-Water is available for Arab countries, they are encouraged to utilize its tools that contribute to the country's national water-related accounts as well as those of the region. However, the major problem of such systems is the designation of a unit or a focal point to be responsible for data collection, insertion and maintenance in order to monitor the system continuously within the existing structures. Therefore, it is recommended to initiate a Water Accounting Unit (WAU) on the national level in the Arab countries which would act as the centre to serve the accounting framework for the various water-related sustainable development issues on local, national, regional and global levels. Such unit can utilize the SEEA-Water or the existing national water accounting system and other applicable accounting systems in order to report on the various water-related indicators that meets a country's priorities.

The challenges are in rendering water accounting a means for supporting sustainable development accounting in the region and whether the establishment of water accounting unit can help to achieve this aim.

2. Water accounting in institutional context

Water accounting is the systematic study of the current status and trends in water supply, demand, accessibility and use in domains that have been specified.

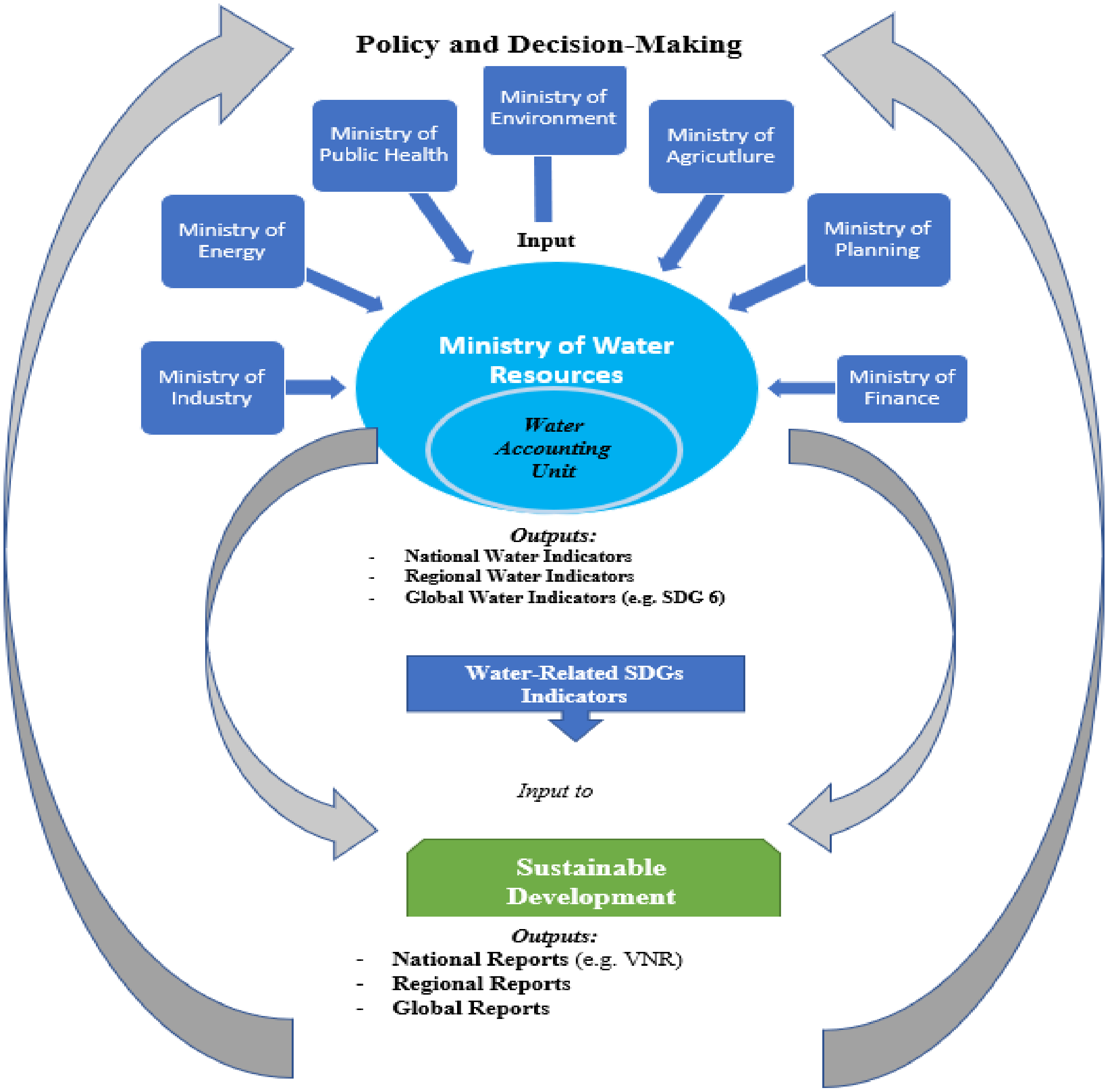
Water accounting is used as a basis for evidence-informed decision-making and policy development.

Source: *FAO, 2017.*

As emphasized throughout this report, water plays a substantial role in the 2030 Agenda for Sustainable Development because of its centrality to each of the three dimensions (society, economy and environment) that intersect all SDGs: the progress towards SDG 6 is indispensable for the progress of the other goals and vice versa. Thereby, water accounting helps to monitor and achieve the 17 SDGs on economic growth, poverty reduction, well-being and environmental protection.
A Water Accounting Unit would form a robust centre for reporting and monitoring of water-related issues starting at the local level reaching the global level. The suggested framework in figure 21 shows how Arab countries can implement water accounting through an integrative and intersectoral approach that includes different institutional stakeholders in relation to the water sector. Ultimately, water accounting shall help in accounting for sustainable development since water interlinks all the different SDGs (as explained in Chapter 1). However, it is the duty of national governments to determine which institutional stakeholders to be specifically involved; other ministries can be added or removed, or local institutional stakeholders can be added to the framework. In case of countries which already have a water accounting system in place, this framework shows that the role of water accounting can be optimized to serve accounting for sustainable development through an intersectoral and multi-stakeholder approach. Furthermore, countries can assess the need of establishing a water accounting unit, such as Egypt which is in the process of developing a WAU in conjunction with the National Water Resources Plan 2017-2037. The WAU will be aligned with national statistical data provision units as well as in the Central Agency for Public Mobilization

and Statistics (CAPMAS). The suggested framework requires that the Ministry of Water Resources specify its priorities in terms of the needed information, data and indicators to be utilized which can be aligned with the SEEA-Water, for example. Once Arab countries implement this framework, it will be easier for them to report on regional and global indicators and to monitor their own progress as well to develop proper intersectoral policies and minimize data gaps. In other words, a Water Accounting Unit acts as a national information hub to guide policy- and decision-making processes. The interlinkages presented in chapter 1 can be thus reported and monitored through the suggested framework.

Figure 21. Suggested Framework for Establishment of Water Accounting Units



Usually, a WAU is responsible for collecting and analysing accurate information and producing detailed accounts on the hydrological cycle, water demands, availability, uses, storage, pumping and other aspects. However, the above framework expands the role of the water accounting unit to include other ministries and institutional stakeholders to collect additional water-related data and information in order to inform intersectoral policies and decision-making. For example, by including the Ministry of Health in this national accounting framework, the water accounting unit would thus gather information related to water-borne diseases which informs SDG target 3.3 and indicator 3.3.3 (annex 2). In this case, the concerned ministries (such water and health) and their designated departments as well as the impacted communities and other stakeholders (hospitals, laboratories, etc.) would be involved in the reporting and monitoring process in addition to the actions and policies that follow. Such information can be initially available at the local and national level, but the key is in the communication channel that can effectively share the data for national and global reporting purposes. Another example from the above framework is the inclusion of the finance sector which can inform about the availability of finance and investments for water-related projects including infrastructure and other sectors such as the agriculture sector. It is essential to allocate financial resources efficiently and inform the governments about investment needs and official development assistance for instance. Furthermore, as illustrated in chapter 3, climate change is a stressing factor on water and land resources in the region, so analysing data from the agriculture sector due to the impacts of climate change is crucial to inform future policies and adaptation measures as well as global reporting through the VNRs and NDCs. Moreover, it is important to analyse information on floods and water-related disasters that are exacerbated by climate change in various sectors.

This framework can be as sophisticated as a country needs and aims to be flexible with the existing institutional structure, yet to enhance a multi-stakeholder approach and cross-sectoral integration of reporting and monitoring of water-related goals, targets and indicators. This framework can also identify the gaps in data and indicators as well as ensuring the reliability of data from multiple institutions for use in policy formulations and reporting globally.
In some cases, the data would be available but not measured against a specific indicator, and in some other cases, a global indicator may be required but its data is not available. Here it is the responsibility of the national government to carry out an assessment for prioritizing indicators and data needed based on the local and national circumstances. On the other hand, in some Arab countries there may already be different frameworks in place to monitor the SDGs. For instance, a sustainable development unit could be initiated in key sectors/ministries to track progress on the respective SDGs targets and indicators. No one framework is better than another, but the government can decide on the most efficient and suitable scheme for the national specificities and accordingly determine the roles and responsibilities for the involved actors/units.

In conjunction with the suggested framework, effective regulatory frameworks need to be consistent with the existing global targets and indicators. There is also a need for a wide-ranging inventory to address gaps and then undertake more in-depth system analysis for identifying synergies and entry points for achieving policy integration. Reviewing existing strategies and plans at the national, subnational and local levels and then comparing these with the global SDGs and targets would assist to transform the global targets and indicators into the national policy frameworks at all levels. Such processes should involve all levels of the government through conducting an actor mapping that provides the existing settings of development strategies and plans across the country and the required adjustments.

C. Means of implementation

1. Capacity development

The first means of implementation for SDG target 6.a is to "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". The corresponding indicator however tracks only the amount of water- and sanitation-related official development assistance (ODA) that is part of a government-coordinated spending plan which does not reflect how capacity-building support is pursued and measured apart from the financial support. Additionally, capacity-building should involve technical, institutional and manpower strengthening to address water-related SDGs and interlinkages and achieve policy coherence across water-dependent sectors. Significant capacity development is needed in the Arab region for the monitoring and implementation of SDG targets and indicators which will require the production of reliable data accounts to properly track progress on national and global targets and indicators. This can be done through implementing capacity-building programmes in partnership with the private sector and academic institutions that have developed experience in new and innovative statistical tools for data collection, disaggregation, analyses and dissemination. Such partnerships can leverage the efficient optimization of resources by utilizing new technologies to inform evidence-based decision-making.

Capacity development has a crucial role in achieving policy coherence across water-dependent sectors. Capacities of institutions and individuals should be strengthened in legislative, financial and technical areas at all levels. Furthermore, capacity-building programmes and activities should be implemented through an integrated approach that covers all of the mentioned areas in order to optimize decision-making through the water sector. SDG interlinkages provide a foundation to develop capacities and thereby should be mainstreamed in national monitoring systems. Nevertheless, there are gaps in data collection and monitoring and these can be resolved through enhancing capacities of experts at the line ministries as well as statistics offices. For example, water accounting can be capacitated as one of the instruments or tools that can resolve data gaps not only in the water sector,[142] but also across the main socioeconomic sectors as water is central in the 2030 Agenda.

2. Technological developments and partnerships

(a) Advancing desalination technologies in the water supply sector

In some Arab countries, governments are collaborating with research institutions, the private sector and other stakeholders to draw upon latest knowledge available on desalination technologies to develop solutions that better respond to local market demand. One of these success stories is the Abu Dhabi Government sponsorship of the Renewable Energy Water Desalination Pilot Programme launched by Masdar in 2013, with support from the private sector represented by leading companies in the field, to test and demonstrate the applicability of various solar-powered desalination configurations to the Arab region context. Seawater desalination through solar powered reverse osmosis was confirmed as the most efficient technology with 75 per cent improvement in energy consumption compared to current practices.[143]

A good example of how collaboration efforts across sectors and with support from international actors can advance the localization of desalination technologies can be illustrated by the completion of the largest adsorption chiller installation in the world in Saudi Arabia. The technology is the result of collaboration efforts by the King Abdullah University of Science and Technology (KAUST) with several engineering companies and consulting firms. The technology provides an effective desalination solution that can treat seawater, brine water, and other highly polluted industrial wastewater directly with minimum pre-treatment required and reduced energy requirements at lower operation costs. The patent rights for the Adsorption Desalination and Cooling (ADC) technology are co-owned by the King Abdelaziz City of Science and Technology (KACST) and the National University of Singapore (NUS).[144]

The use of solar power to operate desalination plants in the Arab region is expanding. Despite being more expensive than other renewable energy options such as photovoltaic (PV), experts believe that concentrated solar power (CSP) applications in desalination present a more suitable renewable energy option for the Arab region. Furthermore, rapid improvements and developments in solar-powered desalination technologies associated with better economic feasibility are taking place in the region. For instance, at the Noor 1 complex in Morocco, the largest CSP plant in the Arab world, the power generated in 2012 was achieved at a rate of $18.9 cents/kWh. Five years later, and following technological advances, solar power generated under comparable conditions reached $9.45 cents/kWh in the Dubai Electricity and Water Authority (DEWA) project implemented in the United Arab Emirates. This shows that there is substantial potential for cost reduction in operating desalination plants which would have direct implications on the application scale and scope of solar seawater desalination in the Arab region.[145]

(b) Augmenting treatment and reuse of wastewater

Some Arab countries have been pioneering state of the art water treatment technologies which were made possible through strategic partnerships with global leaders in the field. A good example of this is the Al-Samra wastewater treatment plant in Jordan which was constructed in 2008 under a 25-year build-operate-transfer (BOT) contract between the national government and SUEZ, global water services, with a capacity of 267,000 m^3 per day which accounts for 70 per cent of wastewater treated in the country. Furthermore, the deployment of energy recovery technologies in situ supported the generation of 80 per cent of energy requirements through biogas production and hydro energy. By that, the treatment plant is now considered among the first in the world to achieve almost full energy efficiency.

The system operation and maintenance are conducted based on latest technologies available in the field drawing upon knowledge, skills and capacities available within SUEZ. It is worth noting that the technical know-how and expertise were transferred to national staff to ensure sustainability and support localization of the technology to the national context.[146]

(c) Private sector engagement in water service delivery

In support of a better engagement of the private sector in water service delivery, many Arab countries, notably in the GCC subregion, have been advancing public sector reforms through the simplification of existing regulations, opening up water and energy utilities to private investors and facilitating investment schemes.

There are many examples of successful public private partnership in the Arab region that can illustrate efficiency of application of these models to the region. In Kuwait for example, the Sulaibiya Waste Water Treatment Plant (WWTP) established in 2004 is considered the largest sewage treatment plant in the Arab world. It is estimated that over the life of the project the Government's savings will amount to $11 billion under that scheme when compared to centralized Government-supported treatment approaches. The savings can be attributed to an overall improved management efficiency along with the generation of marketable products such as the production of fertilizers from sludge.[147]

Another example is the New Cairo Wastewater Treatment Plant which was completed in March 2012 and is considered as the first country's successful public-private partnership (PPP) project. The project was financed by a loan estimated at $140 million, provided by a group of four Egyptian banks to cover most of the engineering, procurement and construction expenses.

The private sector engagement has also supported innovative financing schemes that aim to support cost recovery while maintaining accessibility to the vital resource. In the case of the As Samra wastewater treatment plant, a combination of private, local government and donor financing was deployed through an innovate arrangement referred to as the "viability gap funding". This resulted in a financially feasible scheme which makes water available to consumers at affordable tariffs without the need for government subsidies. As Samra innovative financing has pioneered a new model for viability gap funding for the Arab region. The project received a WEX Global Award for innovative financing and a World Finance Infrastructure Award in 2013.[148] Encouraging private partners' involvement will help enhance the transfer of technological advances, optimize financial and economic efficiency, increase accountability and improve the quality of the services provided.

Figure 22. Sulaibiya Wastewater Treatment and Reclamation Plant

Source: From a presentation on "The Sulaibiya Wastewater Treatment and Reclamation Plant" delivered by the Utilities Development Company during the sixth Zayed Seminar, Green Economy Manama, May 2013.

3. Water-related finance

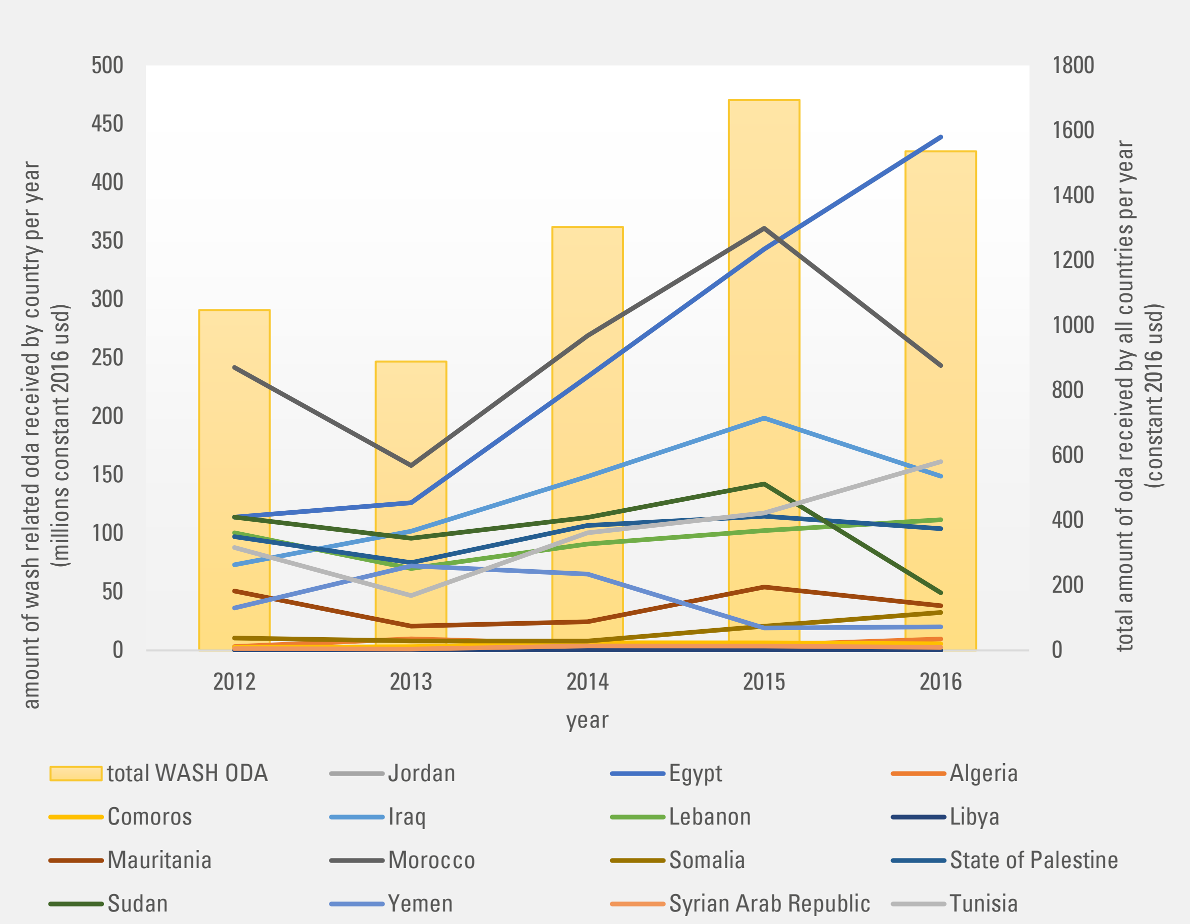
Official development assistance (ODA) for water and sanitation is one significant source of international financial flows received by Arab States to help achieve universal water-related targets. These flows fluctuate from a year to another depending on economic, political and other factors. Arab countries need to make best use of these financial resources and plan their spending in national water and development strategies through an efficient approach.

Regarding SDG financing, it is estimated that, at the global level, from $5 trillion to $7 trillion is needed to finance the sustainable development path.[149] At the Arab region level, the financing gap for achieving the SDGs was estimated for the years 2015 and 2016 to range from $80 billion to $85 billion per year.[150] Investments directed towards the achievement of SDG 6 are expected to generate socioeconomic and health benefits which outweigh the sums to be invested in the sector. However, in most developing countries, there is a need for external support to cover interim periods while domestic funds are being mobilized and developed to address national challenges. SDG indicator 6.a.1 is dedicated to measure “the amount of water-and sanitation-related official development that is part of a government-coordinated spending plan”, yet only the total amount of water-and sanitation related ODA is reported by the statistical division of DESA.[151]

Figure 23 shows the data available for 15 Arab countries as well as the total amount received by these countries during 2012-2016. The highest total amount of the ODA for the Water, Sanitation and Hygiene (WASH) for all Initiative was received for the region in 2015 with eight countries, including Egypt, Iraq, the Sudan and the State of Palestine, receiving the most. The year 2016 shows the second highest total amount of WASH ODA received by the Arab region which could be due to the conclusion of the MDG agenda in 2015 and the adoption of 2030 Agenda for Sustainable Development. There are other economic and political reasons that influence the amount of ODA provided by developed countries to the developing ones. Moreover, how countries define ODA and how it is reported by the OECD and the recipient country could show some discrepancies. The numbers can be more comprehensively analysed and assessed when indicator 6.a.1 is complete to show how the recipient governments are coordinating their WASH related spending plans in proportion to WASH related ODA.[152]

In addition to SDG-related financing opportunities, Arab countries should be aware of others, such as those related to climate financing. For example, when comparing climate finance flows to the water sector with climate finance flows to energy, they receive comparable shares of grant finance but energy receives a much higher share of loan finance.[153] This is likely attributed to the fact that there are fewer bankable investment opportunities in the water sector than in the energy sector. Thereby, Arab countries should encourage investment in the water sector and public-private partnerships can be an option and depending on what approach governments prefer to take, there should be an enabling institutional environment to encourage the feasibility of such investments. Again, countries should explore the different financial options and opportunities for the water sector as well as climate-related finance related to water issues such as those funds related to the adaptation to climate change impacts in the Arab region.

Figure 23. Amount of water-and-sanitation related Official Development Assistance (in millions constant 2016 USD) received by Arab countries during a five-year period, 2012-2016



Source: DESA, from Creditor Reporting System (CRS) database (accessed on 10 April 2018); Organization for Economic Co-operation and Development (OECD).

D. Key messages and recommendations

The following recommendations are suggested to cope with water scarcity in the region within the context of water-related SDGs and national priorities:

- Assessing water-related SDGs in order to select priority targets and indicators according to national circumstances and needs and that are most relevant to a country's sustainable development agenda. This would require setting out new or adjusting existing targets and indicators to measure progress towards national as well as global goals;

- Adjusting existing national institutional settings and making use of the proposed institutional framework in this report to adjust the role and mandate of national institutions and concerned units for successful monitoring and implementation of SDGs and mainstreaming related targets and indicators in national water policies and strategies;
- Developing local and national institutional capacities to mainstream the SDGs in national development strategies and plans to be integrated within the national reporting and monitoring processes in order to efficiently use the available resources;
- Strengthening the capacities of statistical institutions to enable the utilization of existing tools for data monitoring and analyses and integrating water accounting in the reporting and implementation systems of SDGs;
- Engaging the local communities and civil society in the data collection and implementation process of water-related SDGs in order to produce more comprehensive data accounts that would help inform national water policies;
- Ensuring gender mainstreaming in water and sanitation and related goals as well as in national strategies and action plans and engaging of all stakeholders such as youth, local actors, vulnerable groups, etc., through decentralized entities and constituents of the proposed institutional structure for implementation of SDGs at the national level;
- Maximizing the utilization of non-conventional water resources and advancing related technologies to bridge the gap between supply and demand which also plays a key role in the projection of future water balance at various levels (including small areas and catchments) within the context of implementation of SDG 6 targets and indicators;
- Utilizing future projected climate scenarios based on RICCAR to inform short- and medium-term operational plans in water strategy that considers SDG interlinkages. This approach will assist country planners to develop optimization methods of water allocation among the key sectors and to adopt water resources management tools and decision support systems that can directly inform relevant targets and indicators of SDG 6;
- Encouraging investments in research and technology; especially the research involved in adapting and developing technologies to cope with climate change impacts and water scarcity in the region;
- Engaging the science and technology communities in the national SDGs implementation process, as science and technology are strategic means of implementation of the science-policy interface that informs evidence-based decision-making.

Annex 1

Data for SDG 6 indicators in the Arab countries

SDG Indicator	6.1.1[a] (%)	6.2.1a[b] (%)	6.3.1[c] (%)	6.3.2[d] (%)	6.4.1[e] (USD/m^3)	6.4.2[f] (%)	6.5.1[g] (0-100)	6.5.2[h] (%)	6.6.1[i] (%)
Country									
Algeria	-	18	18	-	15.5	88	48	-	77.9 gain
Bahrain	99	96	-	-	45.1	206	40	-	4.22 loss
Comoros	-	-	-	-	20.4	1	26	-	7.28 loss
Djibouti	-	36	-	-	-	8	-	-	4.69 loss
Egypt	-	61	58	-	3.8	160	40	-	14.43 loss
Iraq	59	41	21	-	1.3	93	25	13.5	14.79 loss
Jordan	94	81	81[j]	92	26.5[k]	151[l]	63	21.9	-0.05 gain[m]
Kuwait	>99	>99	100	-	70.7	2603	82	-	-
Lebanon	48	22	13	50	23.3	33	32	-	3.45 loss
Libya	-	26	17	-	18.5	1072	47	-	1.25 loss
Mauritania	-	-	NA	-	1.9	16	45	-	7.81 loss
Morocco	70	39	42	79	7.1	49	64	0	24.95 gain
Oman	90	-	-	-	32.3	106	33	-	4.23 loss

SDG Indicator	6.1.1[a] (%)	6.2.1a[b] (%)	6.3.1[c] (%)	6.3.2[d] (%)	6.4.1[e] (USD/m^3)	6.4.2[f] (%)	6.5.1[g] (0-100)	6.5.2[h] (%)	6.6.1[i] (%)
Country									
State of Palestine	88	61	64	-	15.7	49	-	-	-
Qatar	96	96	79	-	233.9	473	82	0	3.76 gain
Saudi Arabia	-	78	70	-	19.4	1243	57	-	3.72 gain
Somalia	-	14*	1	-	0.1	30	10	0	17.45 loss
The Sudan	-	-	-	86	1.6	94	40	-	32.55 gain
Syrian Arab Republic	-	-	-	-	2.8	109	-	-	4.22 loss
Tunisia	93	78	67	-	10.8	94	55	80.5	0.21 loss
United Arab Emirates	-	96	98	67	69.8	2346	75	-	4.45 loss
Yemen	-	-	-	-	7.3	228	39	-	0.48 loss

[a] The data for this indicator represent percentage of population having access to safely managed drinking water services in 2017. WHO/UNICEF JMP, 2019.

[b] The data for this indicator represent percentage of population having access to safely managed sanitation services in 2017. WHO/UNICEF JMP, 2019. The latest data for Somalia is from 2015 as it was not updated in the most recent JMP report.

[c] The data for this indicator represents percentage of domestic wastewater safely treated (rounded to the nearest whole number). WHO, 2018a.

[d] UN-Water and UNEP, 2018a. The assessment periods are: Jordan (2015-2016); Morocco and the Sudan (2016-2017); United Arab Emirates (2005-2016); Lebanon (1990-2017). Only groundwater was assessed in United Arab Emirates.

[e] UN-Water and FAO, 2018a. Data are for the baseline year 2015.

[f] UN Water and FAO, 2018b. Data are for the year 2014.

[g] UN-Water and UNEP, 2018b. Data are for the year 2017.

[h] UN-Water, ECE and UNESCO, 2018.

[i] UN-Water and UNEP, 2018a. These values are for the sub-indicator spatial extent of open water bodies. Data is for the period 2011-2015 compared to the baseline period 2001-2005. data is also available for the period 2006-2010. UN-Water and UNEP, 2018c.

[j] The value for this indicator is 64 per cent as reported in Jordan's VNR 2017.

[k] The value for this indicator is 20.58 USD/m^3 as reported in Jordan's VNR 2017.

[l] The value for this indicator is 133 per cent as reported in Jordan's VNR 2017.

[m] Jordan reported 17 per cent total change in extent of all sub-indicators under indicator 6.6.1 in its NNR report 2017.

Annex 2

Explicit water-interlinkages in the 2030 Agenda for Sustainable Development

SDG target	Indicator	Related SDG 6 target	Related SDG 6 indicator
1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	1.4.1 Proportion of population living in households with access to basic services	6.1 6.2	6.1.1 6.2.1a 6.2.1b
3.3 By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases	3.3.3 Malaria incidence per 1,000 population	6.1 6.2	6.1.1 6.2.1a 6.2.1b
3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)	6.3	6.3.1 6.3.2

SDG target	Indicator	Related SDG 6 target	Related SDG 6 indicator
4.A Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all	4.A.1 Proportion of schools with access to: (a) electricity; (b) the Internet for pedagogical purposes; (c) computers for pedagogical purposes; (d) adapted infrastructure and materials for students with disabilities; (e) basic drinking water; (f) single-sex basic sanitation facilities; and (g) basic handwashing facilities (as per the WASH indicator definitions)	6.1 6.2	6.1.1 6.2.1a 6.2.1b
8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead	8.4.1 Material footprint, material footprint per capita, and material footprint per GDP 8.4.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP	6.4	6.4.1
11.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	11.1.1 Proportion of urban population living in slums, informal settlements or inadequate housing	6.1 6.2	6.1.1 6.2.1a 6.2.1b

SDG target	Indicator	Related SDG 6 target	Related SDG 6 indicator
12.2 By 2030, achieve the sustainable management and efficient use of natural resources	12.2.1 Material footprint, material footprint per capita, and material footprint per GDP 12.2.2 Domestic material consumption, domestic material consumption per capita, and domestic material consumption per GDP	6.4	6.4.1
12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	12.4.1 Number of parties to international multilateral environmental agreements on hazardous waste, and other chemicals that meet their commitments and obligations in transmitting information as required by each relevant agreement 12.4.2 Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment	6.3	6.3.1 6.3.2
14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	14.1.1 Index of coastal eutrophication and floating plastic debris density	6.3 6.6	6.3.1 6.3.2 6.6.1

SDG target	Indicator	Related SDG 6 target	Related SDG 6 indicator
14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	14.2.1 Proportion of national exclusive economic zones managed using ecosystem-based approaches	6.6	6.6.1
15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements	15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type	6.6	6.6.1

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Endnotes

Chapter 1

1. UN-Water, n.d.
2. Tier I indicators have a known methodology and a historical record; Tier II indicators have a known methodology, but not a historical record; and Tier III indicators that have neither a methodology nor a historical record they are being worked on and being updated. As of September 2019, some of SDG 6 indicators were still classified as Tier III.
3. UN-Water, 2016a.
4. WHO and UNICEF, 2018.
5. WHO and UNICEF, 2019.
6. Ibid.
7. Safely managed sanitation service means a private, improved facility where faecal wastes are safely disposed on site or transported and treated off-site plus a handwashing facility with soap and water, while basic sanitation service means private. improved facility which separates excreta from human contact. WHO/UNICEF JMP (2015).
8. WHO and UNICEF, 2019.
9. Ibid.
10. Custodian agencies utilized data on “piped sewers – treated at treatment plant” from MDG+ Initiative, 2012.
11. The methodology of indicator 6.3.2 uses a water quality index that comprises data from the analysis of basic, core water-quality parameters. Water quality is thus assessed by comparing the national indicators reported to the set target values of the parameters.
12. UN-Water and UNEP, 2018a.
13. FAO, available at http://www.fao.org/sustainable-development-goals/indicators/642/en/ (accessed on 26 November 2018).
14. ESCWA, 2019a.
15. UN-Water and UNEP, 2018c.
16. ESCWA, 2019b.
17. Comoros is the only Arab countries does not share any transboundary waters and as such was excluded from SDG 6.5.2 reporting.
18. UN-Water, UNECE and UNESCO, 2018.
19. ESCWA, 2018a.
20. Nationally derived (in situ) data for subindicators of indicator 6.6.1 collected in 2017 are available and validated for only three Arab countries (Lebanon, Morocco and the Sudan).
21. UN-Water and UNEP, 2018c.
22. Millennium Institute, n.d. Available at https://www.millennium-institute.org/isdg (accessed on 2 December 2018).
23. Explicit SDG 6 (targets and indicators) linkages with other SDGs (targets and indicators) are presented in annex 2.
24. ESCWA, 2017.
25. United Nations Convention to Combat Desertification, 2014.
26. Ibid.

27. Sulayem and Joubert, 1994.
28. ESCWA, 2017b.
29. Barghouth and Al-Sa’ed, 2009.
30. United Nations, 2018.
31. Al-Zubari, 2015.
32. Andres and others 2019.
33. Kayaga and Smout, 2014.
34. ESCWA, 2017c.
35. Al-Zubari, 2015.
36. Rogers, Bhatia and Huber, 1996.
37. International Labour Organization (ILO), 2018.
38. Grey water is wastewater generated from use of domestic water in activities such as washing clothes and dishes, bathing and other household water uses.
39. IDRC and CSBE, 2010.
40. ESCWA, 2019a.

Chapter 2

41. WHO and UNICEF, 2018.
42. Ibid.
43. Ibid.
44. Ibid.
45. Ibid.
46. World Health Organization (WHO), n.d.
47. WHO, 2018.
48. State of Palestine Voluntary National Review, 2018.
49. UN-Water, 2015.
50. UN-Water, n.d.b.
51. Alaammeli, 2018.
52. Ibid.
53. Fletcher and Schonewille, 2015.
54. Ibid.
55. Immerzeel, 2011.
56. Ibid.
57. Jordan Ministry of Water and Irrigation, n.d.
58. Ibid.
59. Arab Republic of Egypt, 2018, p. 34.
60. Egypt, Minister of Water Resources and Irrigation, 2018.
61. These challenges are summarized from the National Water Resources Plan (NWRM 2005-2017) and the environmental dimension of Egypt’s Vision 2030.
62. Bouchrika, Jouber and Bardi, 2015.
63. UN-Water and FAO, 2018.

64. ACSAD and ESCWA, 2017.
65. ESCWA, 2017d.
66. Representative Concentration Pathway (RCP) 4.5 refers to moderate emissions scenario and RCP 8.5 refers to a high emissions scenario.
67. ESCWA, 2019b.
68. United Nations Economic Commission for Europe (UNECE), 2016.
69. Government of Sweden and United Nations Development Programme (UNDP), 2013.
70. Bushnak, 2010, pp. 129-130.
71. Ibid.
72. Deliberation during a Special Session 3 on Water and the SDGs: An Arab Perspective, in the Arab Forum for Sustainable Development, Beirut, May 2018. See https://www.unescwa.org/events/arab-forum-sustainable-development-2018.
73. Ibid.
74. WIPO, 2011.
75. ESCWA, 2018a.
76. Operational arrangement is defined as any treaty, convention, agreement or other formal arrangement, joint body for transboundary water cooperation, annual meeting, annual exchange of data and information or adoption of joint/coordinated water management plan or joint objectives.
77. ESCWA, 2019a.
78. ESCWA, 2019a.

Chapter 3

79. Immerzeel and others, 2011.
80. The PCRaster Global Water Balance (PCR-GLOBWB) hydrological model concepts are comparable to the HBV model, or Hydrologiska Byråns Vattenbalansavdelning model, with the main difference is the latter is fully distributed and implemented on a regular grid.
81. Droogers and others, 2011.
82. Nakicenovic and others, 2000.
83. Swedish Meteorological and Hydrological Institute and ESCWA, 2017. See also for further information on the various GCMs.
84. Luck and others, 2015.
85. Thomas, Behrangi and Famiglietti, 2016.
86. Lewis and others, 2018.
87. Voss and others, 2013.
88. Ibid.
89. Alwash and others, 2018.
90. Al-Ansari, 2016.
91. مجلة سياسة وأمن واقتصاد، 2019.
92. ESCWA, 2017b, p. 12.
93. Ibid.
94. Hirich and others, 2016.
95. ESCWA, 2017b.
96. Lewis and others, 2018.
97. Zaki and others, n.d.

98. Water spreading is diverting or collecting run-off from natural channels, gullies, or streams with a system of dams, dykes, ditches, or other means, and spreading it over a relatively flat area.
99. Zaki and others, n.d.
100. Al-Maktoumi, Zekri and ElRawy, 2016.
101. Al-Qaran and Mohamed, 2016. Unpublished.
102. LAS, ESCWA and ACUWA, 2016.
103. Missimer and others, 2014.
104. ESCWA, 2017b. Dawoud, 2017.
105. Lewis and others, 2018.
106. ESCWA, 2017b.
107. Ibid.
108. Salameh, Abdallat and van der Valk, 2019.
109. Lebanon, Ministry of Energy and Water and UNDP, 2014.
110. FAO, 2018.
111. Abdel-Shafy, and others 2010.
112. Batisha, 2012.
113. Lewis, 2018.
114. El-Sadek, 2010.
115. Sadek, 2009.
116. Brika, 2018.
117. Mualla, 2018.

Chapter 4

118. United Nations, 2015.
119. Ibid.
120. Ibid.
121. Ibid.
122. See https://sustainabledevelopment.un.org/hlpf/2019#vnrs.
123. Egypt, 2018.
124. Saudi Arabia, 2018, p. 71.
125. Ministry of Housing, Utilities and Urban Communities, Ministry of Agriculture and Land Reclamation, Ministry of Electricity and Renewable Energy, Ministry of Trade and Industry, Ministry of Health and Population, Ministry of Local Development, Ministry of Environment, Ministry of Transportation, Ministry of Planning and Ministry of Tourism; in addition to Ministry of Water Resources and Irrigation.
126. Egypt, n.d.
127. See the National Water Strategy (2016-2025) for the set of principles to guide future water sector planning and the analysis of water resources management in Jordan, pp. 3, 8, respectively.
128. Ibid, pp. 38-48 on water for irrigation, energy industry/tourism and climate change adaptation.
129. Namrouqa, 2018.
130. Center for Environment and Development for the Arab region and Europe (CEDARE), 2014.
131. Sahara and Sahel Observatory, 2018.
132. وزارة الفلاحة، 2018، تونس.

133. African Water Facility and African Development Bank, 2010.
134. The other pilot countries are Costa Rica, Ghana, Republic of Korea and Pakistan.
135. United Nations University, Institute for Water, Environment and Health, 2019.
136. International Water Resources Association, 2017.
137. FAO, 2014.

Chapter 5

138. Bebbington and Unerman, 2018.
139. United Nations System of Environmental-Economic Accounts (UN-SEEA), n.d.a.
140. UN Statistics Division, 2013.
141. UN-SEEA, n.d.b.
142. ESCWA, 2018d.
143. Masdar, 2018.
144. KAUST, 2016.
145. Helioscsp, n.d.
146. ESCWA, 2017e.
147. Biygautane, 2016.
148. World Finance, 2013.
149. ESCWA and UNEP, 2015.
150. Ibid.
151. DESA, 2017.
152. UN-Stats, 2016.
153. This is based on public international flows from annex II parties to the United Nations Framework Convention on Climate Change (UNFCCC) to Arab States, through bilateral, regional, and other channels, based on data reported by annex II states to the UNFCCC in their third biennial reports.

Water-related SDGs have a central role in achieving the 2030 Agenda for Sustainable Development and its interlinked Sustainable Development Goals (SDGs) and targets. While the dedicated goal on water (SDG6) aims to ensure availability and the sustainable management of water and sanitation for all, pursing this goal supports the achievement many other goals. Regional monitoring and reporting of the water-related SDGs thus supports a better understanding of water across the sustainable development agenda and provides insights on the progress and challenges facing the Arab region as it aims to achieve the SDGs and associated national targets under conditions of water scarcity and increasing water stress.

This eighth issue of the Water Development Report of the Economic and Social Commission for Western Asia (ESCWA) examines the water-related SDGs from the perspective of water security and scarcity in the Arab region. It identifies ways to assess and address present and projected water scarcity at the regional and national levels for various climate change scenarios. It reviews regional and national water strategies and action plans coherency with global water-related goals and targets. The study analyses how the water-related SDG targets and indicators can guide the development of policy measures to tackle water challenges in the Arab region. Proposed policy interventions include measures to conserve and protect water resources and generate additional nonconventional water resources. Selected policy options are quantified and analysed for two climate scenarios for the future period 2030-2050 in view of informing sustainable planning and appropriate decision support systems to optimize and rationalize water use. The report also provides insights on institutional mechanisms in place for monitoring and implementing water-related SDGs at various scales.

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