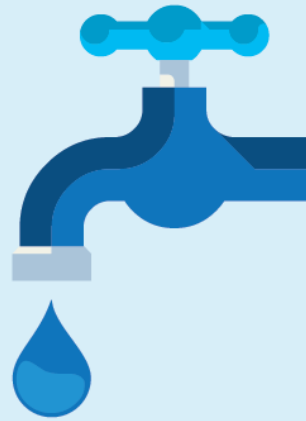




The Ministry of Water and Irrigation

# National Water Strategy

2023–2040





**His Majesty King Abdullah II Ibn Al-Hussien**





**His Royal Highness Crown Prince  
Al Hussein, the Regent**

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## LIST OF ABBREVIATIONS

<b>4NC</b>	Fourth National Communication
<b>AC</b>	Advisory Committee
<b>AFTA</b>	ASEAN Free Trade Area
<b>AW</b>	Aqaba Water
<b>BAU</b>	Business As Usual
<b>bJD</b>	Billion Jordanian Dinar
<b>BOT</b>	Build Operate Transfer
<b>CIS</b>	Customer Information System
<b>CIP</b>	Capital Investment Plan
<b>CG</b>	Consultative Group
<b>CR</b>	Cost Recovery
<b>CRWSP</b>	Climate Resilient Water Safety Plan
<b>DMA</b>	District Metered Area
<b>Disi</b>	Disi Water Conveyance Project
<b>DMS</b>	Data Management System
<b>DOS</b>	Department of Statistics
<b>Du</b>	Dunum
<b>EE</b>	Energy Efficiency
<b>EMRC</b>	Energy and Mineral Regulatory Commission
<b>EnMS</b>	Energy Management Systems
<b>ERP</b>	Enterprise Resource Planning
<b>GCF</b>	Green Climate Fund
<b>GCMs</b>	Global Climate Models
<b>GDP</b>	Gross Domestic Product
<b>GESI</b>	Gender Equality and Social Inclusion
<b>GHG</b>	Greenhouse Gas
<b>GHI</b>	Global Hunger Index
<b>GIS</b>	Geographic Information Systems
<b>GIZ</b>	Gesellschaft für Internationale Zusammenarbeit GmbH
<b>GoJ</b>	<b>Government of Jordan</b>
<b>GW</b>	Groundwater
<b>GWh</b>	Gigawatt-hour
<b>ICT</b>	Information Communication Technology
<b>ISO</b>	International Organization for Standardization
<b>ISSP</b>	Institutional Support and Strengthening Program
<b>ITC</b>	International Trade Center
<b>JCI</b>	Jordan Chamber of Industry
<b>JD</b>	Jordanian Dinar
<b>JMD</b>	Jordan Meteorological Department
<b>JSMO</b>	Jordan Standards and Metrology Organization
<b>JV</b>	Jordan Valley
<b>JVA</b>	Jordan Valley Authority

<b>KAC</b>	King Abdullah Canal
<b>KPI</b>	Key Performance Indicator
<b>kWh</b>	kilowatt-hour
<b>MCM</b>	Million Cubic Meter
<b>MEMR</b>	Ministry of Energy and Mineral Resources
<b>MENA</b>	Middle East and North Africa
<b>mJD</b>	Million Jordanian Dinar
<b>MoA</b>	Ministry of Agriculture
<b>MODEE</b>	Ministry of Digital Economy and Entrepreneurship
<b>MoEnv</b>	Ministry of Environment
<b>MoF</b>	Ministry of Finance
<b>MoFA</b>	Ministry of Foreign Affairs and Expatriates
<b>MoH</b>	Ministry of Health
<b>MoI</b>	Ministry of Interior
<b>MoITS</b>	Ministry of Industry, Trade and Supply
<b>MoLA</b>	Ministry of Local Administration
<b>MoPIC</b>	Ministry of Planning and International Cooperation
<b>MoTA</b>	Ministry of Tourism and Antiquities
<b>MW</b>	Megawatt
<b>MWI</b>	Ministry of Water and Irrigation
<b>NA</b>	Not Applicable or Not Available
<b>NAP</b>	National Adaptation Plan
<b>NARC</b>	National Agricultural Research Center
<b>NCCC</b>	National Climate Change Committee
<b>NCP</b>	National Conveyance Project
<b>NDCs</b>	Nationally Determined Contributions
<b>NEPCO</b>	National Electric Power Company
<b>No.</b>	Number
<b>NRW</b>	Non-Revenue Water
<b>NWIS</b>	National Water Information System
<b>NWMP-3</b>	Third National Water Master Plan – Prepared by MWI & GIZ (2019-2023)
<b>NWS</b>	National Water Strategy
<b>O&amp;M</b>	Operating and Maintenance
<b>PBL</b>	Prosperity Blue Line
<b>Pop.</b>	Population
<b>PPP</b>	Public-Private Partnership
<b>PSE</b>	Private Sector Engagement
<b>PSP</b>	Private Sector Participation
<b>PVs</b>	Photovoltaics
<b>PWD</b>	Persons with disabilities
<b>R&amp;D</b>	Research and Development
<b>RCP</b>	Representative Concentration Pathway
<b>RE</b>	Renewable Energy
<b>RJGC</b>	Royal Jordanian Geographical Center



<b>RO</b>	Reverse Osmosis
<b>RSS</b>	Royal Scientific Society
<b>SCADA</b>	Supervisory Control and Data Acquisition
<b>SDG</b>	Sustainable Development Goal
<b>SIF</b>	Strategy Implementation Framework
<b>SW</b>	Surface Water
<b>SWOT</b>	Strengths, Weaknesses, Opportunities and Threats
<b>TBD</b>	To Be Determined
<b>TWW</b>	Treated Wastewater
<b>UN</b>	United Nations
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>UPMU</b>	Utilities Performance Monitoring Unit
<b>WAJ</b>	Water Authority of Jordan
<b>WASH</b>	Water, Sanitation and Hygiene
<b>WDZ</b>	Water District Zone
<b>WEAP</b>	Water Evaluation and Planning
<b>WEFE</b>	Water-Energy-Food-Environment
<b>WFP</b>	World Food Program
<b>WGA</b>	Water Governance Activity
<b>WHO</b>	World Health Organization
<b>WMI</b>	Water Management Initiative
<b>WTO</b>	World Trade Organization
<b>WTP</b>	Water Treatment Plant
<b>WUA</b>	Water Users Association
<b>WWTP</b>	Wastewater Treatment Plant
<b>YWC</b>	Yarmouk Water Company

## FOREWORD

The National Water Strategy 2023-2040 provides the vision and pathway to work across government and in partnership with the people to achieve lasting water security for our health, prosperity, and growth. This updated strategy is developed in response to environmental and calling for devising a long-term strategy that addresses the challenges calling for devising a long-term strategy that addresses the challenges facing Jordan.

This vision reflects the steps towards addressing our unprecedented water scarcity challenges. Demographic changes, rapid population growth, climate change impacts, chronic overuse of groundwater, and ongoing reliance on transboundary water are driving an urgent need to increase available water supplies and better manage current water resources. Jordan currently has 61 cubic meters of renewable fresh water available per capita per year, which is far less than the 500 cubic meters per capita annually that is internationally recognized as the absolute water scarcity line.

As our existing renewable water resources are declining, increasing supplies through non-conventional sources have become a critical necessity. The most important and vital supply will be secured through the new National Conveyance Project, along with significant expansion of treated wastewater for reuse in irrigation.

Increasing the supply alone does not ensure water security. We strongly commit to making the best possible use of every drop of water we have by reducing losses from leakage and illegal use—called non-revenue water—to 25 percent by 2040 while increasing efficiencies in water operations.

Additionally, work with water consumers and partners will be continued, aiming at improving water use efficiency, and subsequently increasing economic value of each cubic meter of water used. These actions are accompanied by measures to strengthen the financial performance of the sector and improve cost recovery, especially as the cost of water development, treatment, and service delivery continue to rise significantly.

Central to our strategy is to ensure that a strong foundation for sector governance, management and operation is put in place. This strategy modernizes existing water sector institutions and restructures them in order to streamline operations, ring-fence costs, and better allocate institutional responsibilities. Greater corporate autonomy will be instituted for the water companies while simultaneously strengthening corporate oversight through an independent regulatory body that monitors and publicly reports on water and wastewater service levels.

People are at the center of our management and operations strategy which includes strengthening career development and attracting youth and women to the sector as our next generation leaders. This strategy introduces measures and technologies needed to ensure that accurate and validated data is readily available, and information transparently disseminated, to decision makers and the public.

This strategy is anchored in integrated water resources management to protect and preserve our groundwater aquifers and surface water supplies. This will entail rigorous compliance and enforcement with all relevant laws and guidelines for water use and protection.

There are also specific actions throughout the strategy to address critical cross-cutting issues for water sector management which include financial performance and sustainability, data-driven decision-making, innovation and technology, energy use, water use efficiency, and climate change.

Finally, this strategy is aligned with national governance reforms and development priorities along with much greater cooperation across governmental institutions and with academia and the private sector. It is produced in parallel with two other governmental initiatives: the Economic Modernization Vision 2022 - 2033 and the Public Sector Modernization Roadmap. Collectively, these efforts reflect the need for broader reform. The water sector is proud to be a part of these collective efforts to meet the long-term needs for Jordan's prosperity and ongoing development.

**Eng. Mohammad Al-Najjar**  
Minister of Water and Irrigation



# 1 INTRODUCTION, APPROACH AND FRAMEWORK

## Introduction

The Ministry of Water and Irrigation is pleased to present the Jordan National Water Strategy: 2023-2040. This strategy presents the critical actions and commitments for the water sector to achieve the urgent national need for lasting water security for the Kingdom. Jordan's water resources are under unprecedented threat that will require the combined efforts of the government, water sector entities, customers, water users, the private sector, academia, civil society, and the donor community. Without water security the health and prosperity of Jordan's people is at risk, food security is unattainable, and economic growth is severely limited.

Water security has been defined as "the reliable availability of an acceptable quantity and quality of water for health, livelihood and production, at an acceptable level of water-related risks"<sup>1</sup>. Over the past decades, Jordan's water risks have rapidly increased due to both natural and human drivers, posing real challenges to achieving water security. The natural causes include Jordan's limited groundwater resources, shrinking surface water flows, and climate change with increasing severity in temperature, evaporation, aridity, floods, and droughts. The human drivers relate almost wholly to over-pumping of groundwater and overuse of surface water which is having severe effects on water quality, available water quantities, and pollution levels along with the storage, retention, and recharge capacity of aquifer and basin catchment systems.

## Rationale for the National Water Strategy Update

The recently updated planning documents of the water sector revealed that many circumstances have emerged, and several factors have changed since the last 2016-2025 National Water Strategy. This enlightened the need to revisit the previous national water strategy and further clarify the vision, expected outcomes, responsibilities, and strategic approaches. . These key circumstances and factors are as follows:

- Demographic changes and population growth have surpassed previous projections and are seriously affecting water allocation needs for all purposes.
- Sources of water, particularly through large-scale seawater desalination, intended to be available by now in accordance with current and past strategies, have not been developed, which is seriously impacting water supply capacity.
- Climate change effects are becoming more apparent in decreasing rainfall and changes in rainfall distribution and pattern across the Kingdom, resulting in sharp decreases in the volume of water stored in dams and groundwater recharge.
- Drought impacts are intensifying water and food security challenges.
- Additional reliance on purchasing water from international sources has been necessary during recent years, increasing the vulnerability of supply options.
- The need for all parties to abide by the concluded transboundary water agreements.
- Challenges continue in abiding by regional water agreements that secure Jordan's rights to shared water resources.
- Institutional separation between bulk and retail water supply is coming into action, which represents an opportunity for ring-fencing the true cost of water at its various stages of operation and creating the need to revisit the legal and regulatory framework.
- Increased conflicting and vagueness in the relationship between the Water Authority of Jordan and its utilities, beyond bulk and retail functions, has surfaced making it imperative to revisit the existing governance structure.

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<sup>1</sup> Grey, David; Sadoff, Claudia W. (2007). "Sink or Swim? Water security for growth and development". Water Policy. 9 (6): 545–571

- Recognizing that Non-Revenue Water (NRW) is an important issue that has not been sufficiently addressed. Ongoing efforts to manage NRW have been challenging, prompting a serious review of existing policies and legislations, together with their execution and enforcement methodologies.
- The rising cost of water and wastewater services, and the inability to cover such costs, is generating increased attention to the subject of financial sustainability.
- The need for greater efficiency in service provision along with fluctuating energy costs requires addressing these matters periodically.
- The global water sector is witnessing substantial leaps in the application of modern technologies, thus urging Jordan's water sector to stay innovative and abreast with these technologies and to contribute to their development when addressing local needs.
- Significant water sector funding commitments by donors, multilateral agencies, and individual governments, require coordination within the water sector around updated strategic goals.

## Development Approach

The development of the National Water Strategy (NWS) commenced in November 2021 (Figure 1), to devise a long-term water strategy to address the challenges facing Jordan in this sector, with a clear vision. His Majesty emphasized:

- The importance of utilizing technology to address water challenges,
- Identifying the amount of wasted water and addressing this important issue, and
- Taking action to treat and reuse water in agriculture and industry, countering the impact of climate change on the water sector.

The water sector started the process with preparing the strategy development guide, strategy vision, key drivers, targets and high-level outline. And to maximize benefit from the sector's local experiences, and in adoption of the participation and transparency principles, the formation of Consultative Groups (CGs) took place. The CGs' members included representatives from the water sector, donors and key Ministries including the Ministry of Agriculture (MoA), Ministry of Environment (MoEnv) and Ministry of Energy and Mineral Resources (MEMR), academic sector and other key stakeholders. Eight CGs were formed covering the strategy areas as listed in Table 1.

Following the preparation process, the strategy goals, objectives, and targets were developed and presented to the Advisory Committee (AC), which is headed by the Minister of Water and Irrigation and formulated from the water sector leaderships. During the development period, the CGs met bi-weekly to discuss, draft and review the pre-draft chapters of the strategy, taking into consideration all valid master plans, relevant strategies, official references, verified data and other substantial local and international documents and conventions. Additionally, water policies were reviewed, and initial proposed amendments were developed.

After this, the core review and editorial team started the revision process by revising and editing the pre-draft chapters received from the CGs with the aim to 1) streamline and merge goals and objectives to reduce their number and focus them at the strategic level, 2) make the level of details consistent and unified among all strategy chapters, 3) use strategic language and similar style, 4) integrate chapters and develop the strategy framework and pillar goals, 5) add further in-depth analysis to clarify each chapter story.

Then, the draft strategy was revised and finalized by the water sector entities and shared with key stakeholders for review including key ministries, donors' agencies, academia, and private sector. Following this, the strategy was finalized and moved into the approval and endorsement process by the Ministry of Water and Irrigation and the Cabinet.

During the strategy development process, the water sector ensured following the following key principles and approaches:

- **Participatory:** Around 200 individuals from water sector entities and key stakeholders participated in developing and reviewing the strategy.
- **Transparent:** All from water sector entities and key stakeholders were welcomed to provide transparent input and review.
- **Accountability and ownership:** Through applying a results-oriented approach with clear goals, objectives and targets that can be measured and assigned to the right party for monitoring, evaluation, and feedback.
- **Comprehensive and integrated:** Considering the water sector complex interactions among its entities and with all other sectors; where the strategy development and management processes have been done in a comprehensive and integrated way.
- **Actionable strategy:** By developing clearer results, goals, objectives, KPIs, targets and roles, that can be easily transformed into action plans, executed, with monitored, evaluated, and reported progress.
- **Objectivity:** The current situation, challenges, and future assumptions are recognized based on facts and evidence only.
- **Sustainability and innovation:** While the strategy aims to identify and clarify water sector challenges weaknesses, and opportunities, it also tries to propose innovative and sustainable solutions that ensure the sustainability of the water sector.

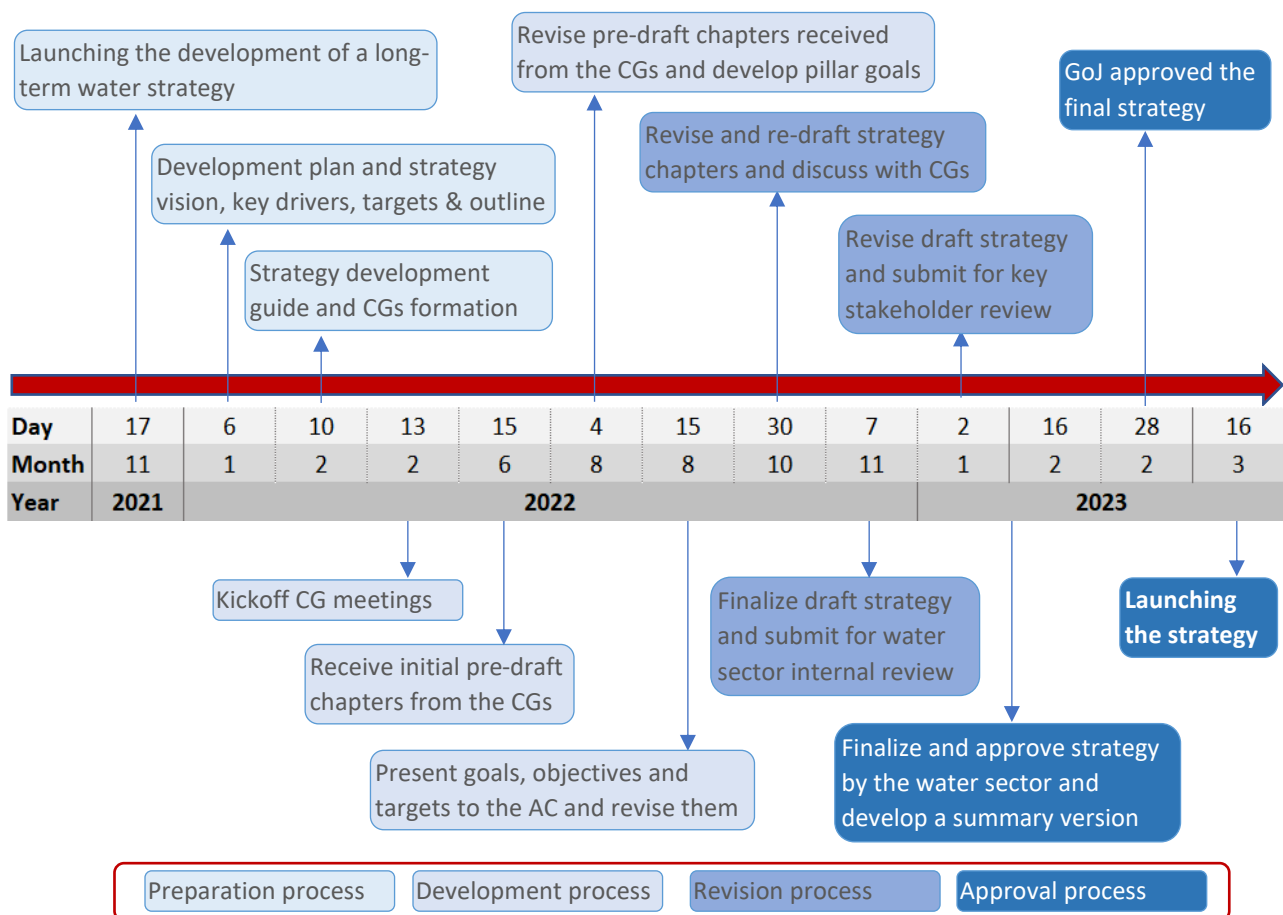


Figure 1: National Water Strategy Development Schedule



**Table 1: Jordan's Water Sector Strategic Areas**

Strategic Area	Consultative Group	Chapter No.
1. Achieving a Sustainable Balance between Supply and Demand	Water Demand and IWRM	3
2. Integrated Water Resources Management (IWRM) and Environmental Protection		0
3. Utility Management and Services	Utility	5
4. Irrigated Agriculture	Irrigation	0
5. Financial Sustainability	Financial	7
6. Sector Governance and Institutional Development	Governance	0
7. Energy Efficiency and Renewable Energy in the Water Sector	Energy	0
8. Innovation, Technology, and Private Sector Engagement	Private sector and research	10
9. Water-Energy-Food-Environment (WEFE) Nexus	Energy	11
10. Climate Change Resilience	Climate Change	12

## National Water Strategy Framework

The Strategy presents the highest priority goals for water resources, related services, infrastructure, and management areas for which the sector is responsible. The Strategy starts with Pillar Goals that frame and drive all goals in each chapter and technical area. Each chapter details the current situation, key challenges and strategic approaches needed to tackle major challenges and needs across the water sector in each critical area. Each goal has corresponding objectives, indicators, and targets to ensure that progress is measurable. This ensures that the water sector entities and national government authorities are accountable to progress against these actions to better manage, protect, and sustain water resources and deliver safe and reliable services to people. Water security requires integrated approaches and synergies as no single approach in isolation will bring about significant effects. A combination of innovations, technical solutions and organizational measures is more likely to result in faster steps toward sustainability. Figure 2 illustrates the framework and structure of the Strategy and Table 1 lists the ten technical areas and their corresponding chapter number.



**Figure 2: Strategy Framework and Structure**

Each technical area chapter from No. 3 to No. 12 can be read as a stand-alone chapter. The Pillar Goals are described in Chapter No 2 and the status and targets for the Sustainable Development Goals (SDGs) are summarized in Annex 1.

## National Water Policies

In addition to the NWS document that provides the comprehensive framework to achieve water sector goals and objectives with clear targets, the water sector has updated the national water policies that provide key principles and rules to guide the decision-making process. These policies are:

1. Groundwater Sustainability Policy
2. Surface Water Utilization Policy
3. Wastewater Management and Reuse Policy
4. Water Demand Management Policy
5. Water Reallocation Policy
6. Energy Efficiency and Renewable Energy Policy
7. Climate Change for a Resilient Water Sector Policy
8. Sector Policy for Drought Management
9. Water Sector Gender Policy

## Alignment with National Visions

Development of the NWS has taken into consideration priorities set by the GoJ in 2022, through two national strategic documents, the Economic Modernization Vision 2022-2033, and the Public Sector Modernization Roadmap 2022-2025, as illustrated in Table 2 and Table 3 below:

**Table 2: Alignment with Economic Modernization Vision 2022-2033**

#	Economic Modernization Vision (Water Sector) 2022-2033 - Proposed Initiatives	Linkage with NWS's Goals and Objectives
1	Upgrade water supply/demand management monitoring and control	IWRM area Goals 1 and 2 / Utilize area Goal 2 Objective 2.3
2	Launch water efficiency and financial self-sustainability	Financial sustainability area/ IWRM area, Goal 4/ Irrigated agricultural area, Goal 4
3	Establish climate resilience and sustainable water use (i.e., clean energy for water)	Climate change resilience area
4	Launch national water desalination projects, including seawater desalination and national conveyance project	Supply-demand area, Goal 1, Objective 1.3
5	Launch water conservation awareness program	IWRM area, Goal 4
6	Develop technological solutions for water sustainability program	Innovation, Technology, and Private Sector Engagement area
7	Launch National Innovation Center	Innovation, technology, and private sector engagement area, Goal 2
8	Establish public-private partnerships including specific investment opportunities	Innovation, technology, and private sector engagement area, Goal 3
9	Proper implementation and enforcement of water laws and regulations	Pillar Goal 1 / IWRM area, Goal 1 and 2 / Utility area Goal 2/
10	Establish Nexus Council (Water, Agriculture, Energy and Environment)	WEFE Nexus area
11	Reduce Non-Revenue Water (NRW) by 2% annually	Utility area Goal 2
12	Improve energy efficiency in the water sector, increase renewable energy use, and exploit water dam energy storage	Energy efficiency and renewable energy and WEFE Nexus areas

**Table 3: Alignment with Public Sector Modernization Roadmap**

Public Sector Modernization Roadmap Goals and Implementation Plan 2022-2025		Linkage with NWS's Goals and Objectives
Framework Element	Strategic Goal	
<b>Governmental Services</b>	Integrated and interconnected government services characterized by ease of access, speed of implementation and ease of procedures.	Utility area, Goal 1
	An institutional culture centered on serving the citizen and their experience obtaining services, based on training, qualification, accountability, reward, and motivation.	
<b>Legislation</b>	Launching a fast track to review, update and align legislation to ensure the implementation of the public sector modernization program.	Governance area, Goal 1
	Enhancing compliance by activating laws, regulations, instructions, and foundations for oversight and accountability.	
<b>Human Resources</b>	<b>Civil service and talent management:</b> Access to a modern work environment that provides opportunities for promotion and career and professional growth, and promotes a culture of accountability and motivation related to performance	Governance area, Goal 1
	<b>Leadership:</b> Facilitating a supportive environment for leaders and enabling them to achieve expected goals and results by promoting a culture of performance linked to achieving results, adopting performance-based accountability and motivation policies, granting authority, and providing continuous development and education.	Governance area, Goal 1
	<b>Leadership:</b> Strengthening the ability to select those qualified to assume leadership positions and preparing the next generation of future and young leaders who possess the competencies and practical experience required to compete for leadership positions, in a way that ensures the sustainability of meeting the government's need for competent, prepared and trained leaders in line with the government's vision.	Governance area, Goal 2
	<b>Leadership:</b> Strengthening the role of women and their participation in various government departments and institutions and raising the percentage of women occupying leadership positions in the public sector.	Governance area, Goal 4
<b>Organizational Structure and Governance</b>	Enhancing the compliance of the regulatory authorities with the foundations of governance to ensure the prevention of duplication, ensure integration in the control work and achieve government compliance with agreed international standards.	Governance area, Goal 1
	Access to a flexible, uncomplicated, integrated, efficient, and citizen-centric organizational and government structure.	Governance area, Goal 2
	Improving the public administration system to enhance individual and institutional performance and develop government services.	Governance area, Goal 2
	Creating a monitoring system on the levels of government performance that links national, sectoral, institutional, and individual goals to the government's directions and strategic vision.	Governance area, Goal 3
	Establishing a governmental institutional framework that focuses on empowering women and providing the necessary resources and capabilities to enhance their political and economic participation.	Governance area, Goal 4
	Developing and amending the current system of legislation, laws, and regulations, in addition to developing the civil service system.	Governance area, Goal 1

Public Sector Modernization Roadmap Goals and Implementation Plan 2022-2025		Linkage with NWS's Goals and Objectives
Framework Element	Strategic Goal	
<b>Policy Making and Decision Making</b>	Involve citizens and stakeholders within and outside the public sector and develop partnerships with scientific and research centers and academic institutions to contribute to impact measurement.	Governance area, Goal 1
	Develop a comprehensive governmental framework for the strategic planning process and adhere to it and the requirements for its implementation.	Governance area, Goal 3
	Develop, computerize, and apply the unified government performance management system to ensure that indicators are linked at the individual, institutional, sectoral, and national levels, and to enhance the principle of results-oriented management and performance indicators.	Governance area, Goal 3
<b>Procedures and Digitization</b>	Reengineering government operational procedures to simplify, streamline and automate as much as possible within and between institutions.	Innovation, Tech. & PSP, Goal 1
	Empowering government agencies with existing joint services to provide flexibility, improve quality, improve customer satisfaction, and achieve cost reduction.	WEFE Nexus area, Goal 1
<b>Institutional Culture</b>	Building an institutional culture and work environment that enhances commitment and accountability and ensures the successful implementation of the modernization map.	Innovation, Tech. & PSP, Goal 2
	Achieving a participatory and cooperative approach between government agencies to achieve and follow-up on common national goals, so coordination between ministries is carried out according to tasks to achieve the priorities and needs of citizens and work to harmonize the process of policy making and decision-making.	WEFE Nexus area, Goal 1



## 2 PILLAR GOALS - WATER SECTOR REFORM AND GOVERNANCE FOR WATER SECURITY

The pillar goals are the framework for all the goals in each chapter and technical area. These are the four goals that must be achieved, without which the country cannot deliver water security or sustainable services for Jordan's economic prosperity and health. Every other goal in the strategy chapters can be linked to these pillar goals, further highlighting the central importance of these as the foundation on which the sector will be governed and basis for prioritizing investments and reforms. These pillars focus on addressing the way in which Jordan's water sector and resources are managed to protect this vital national resource, as follows:

- **Pillar Goal 1:** Reform the legal and institutional framework to modernize the sector, clarify roles and responsibilities, enhance accountability, and increase public trust.
- **Pillar Goal 2:** Restore balance between available and sustainable water supplies and water demand to sufficiently meet Jordan's health and economic development needs to achieve lasting water security.
- **Pillar Goal 3:** Achieve financial sustainability for water sector operations through the balance of full cost recovery and continued government support in critical infrastructure investment and pro-poor protections for water security.
- **Pillar Goal 4:** Ensure impartial and transparent regulation of water sector services and costs.

To provide sufficient water for the many uses needed across the country, water security requires adaptive management with planning, policies and strategies developed to enhance security, address uncertainty, and close knowledge gaps. This is a serious matter that needs structural reforms in existing institutions, ensuring the application of multi-tiered governance, and setting in place clear regulatory mechanisms. This overarching conventional management approach is highlighted by the prominence of the Sustainable Development Goals closely related to nutrition, health, and dignity, which are all critical elements for livelihood.

To achieve water security, especially given the severity of the challenges and the current scarcity levels, significant investments will be needed. Infrastructure upgrades and expansions are required to produce, store, and transport water, and to collect, treat and reuse wastewater. Critical investment extends beyond infrastructure, however, as it must include management capacity for robust institutions, information gathering, and capacity building to predict, plan for, and cope with population growth and climate variability.

The utilities distributing and selling municipal water supplies report non-revenue water at a national average of around 50% in 2020<sup>2</sup>. This is a critical area for sector investment and management. Every percentage reduction in non-revenue water, along with continued reduction year after year, has a direct and immediate effect on available water quantity and revenue generation while being a direct reflection on operational efficiency. Likewise, agriculture has a high-water footprint consuming around 50% of the available freshwater<sup>3</sup>. Any degree to which irrigation's consumption of fresh water can be reduced will directly benefit and support municipal water needs and uses in other sectors for growth. The strategy presents several viable pathways to do so without decreasing the total volume of water used in irrigated agriculture through a focus on increased efficiency and substitution of reclaimed water for scarce freshwater.

Underlying the entire sector's ability to function is the need to achieve financial sustainability. The sector's financial situation is significantly strained resulting from the high cost of operation mainly because of the high energy consumption, and the low average revenue, which all is driven by the increased demands during the pandemic and population surges from an influx of refugees while the country overall has faced severe fiscal pressures. This situation must be stabilized and reversed. The sector, water utilities, and the

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<sup>2</sup> MWI (2022) National Non-Revenue Water Strategy 2022-2040.

<sup>3</sup> MWI & GIZ (2021) Third National Water Master Plan, Volume C.

government must work together on several financial reforms to enable stronger cost recovery and financial viability for efficient and sustainable service provision.

As these reforms take place, however, the Jordanian public need the assurance that consumer and citizen interests are being met. For this reason, the final pillar goal is to establish and empower independent sector regulation. Impartial, evidence-based monitoring, analysis, and reporting of sector performance against key performance indicators and levels of service is essential to hold the sector's institutions and companies accountable to the public. Regulation will build public trust not just in the water sector but in the government's ability to deliver safe and reliable essential services.

Each pillar goal along with its objectives, indicators and targets is presented in tables 4 to 7 below.

**Table 4: Pillar Goal (1): Reform the legal and institutional framework**

<b>Pillar Goal 1: Reform the legal and institutional framework to modernize the sector, clarify roles and responsibilities, enhance accountability, and increase public trust</b> Indicator/Target: The water sector is recognized as effective and responsive with clear organizational mandates for water authorities, independent utility companies, well-regulated services, and good governance	
Objectives	Indicators/Targets
<b>Objective 1.1:</b> Separate legal, institutional, and financial responsibilities of bulk water supply production and transmission from the retail service delivery of water and sanitation services operations and maintenance to clearly delineate responsibilities and ring-fence costs.	Legislative reforms, institutional restructuring, and subsequent institutional strengthening are carried out to effectively: <ul style="list-style-type: none"> <li>• Consolidate water production management functions under one entity by 2025 with the development and management of the water transmission system by 2026.</li> <li>• Transfer all water and sanitation retail service delivery operations and maintenance functions to the water companies by 2026.</li> </ul>
<b>Objective 1.2:</b> Strengthen the enabling environment to ensure that utility companies are constituted as service delivery companies independent in management and operations functions.	Legal and regulatory reforms enacted and operationalized to empower the utility companies to become independent service delivery entities with the Articles of Association for them and the Assignment Agreements between utility companies and the Water Authority of Jordan (WAJ) all amended and enforced by 2024. Compliance is effectively monitored and regulated through an independent regulator from 2025.
<b>Objective 1.3:</b> Develop and sustain independent regulation of water and sanitation services in full transparency to ensure accountability for service performance, protect the rights of water sector customers and companies, and lead to improved public trust.	An independent regulatory body for the water sector is established with a transparent, timely and accurate mechanism for public reporting by 2025. The first independent, accurate, and transparent water sector services performance report is issued to the public by 2026.
<b>Objective 1.4:</b> Separate legal, institutional, and financial responsibilities of irrigation water supply, production, and transmission from provision of retail irrigation water services in the Jordan Valley to clearly delineate responsibilities and ring-fence costs.	Legislative reforms and institutional restructuring completed to transfer all irrigation retail service delivery operation and maintenance functions out of the Jordan Valley Authority and into appropriate retail entities by 2026.
<b>Objective 1.5:</b> Consolidate sector policy, planning, and oversight within the Ministry of Water and Irrigation to strengthen overall sector governance.	Legislative reforms, institutional restructuring, and subsequent institutional strengthening are carried out to effectively transfer all sector policy, planning, water resources management, and oversight functions to the Ministry of Water and Irrigation by 2024. The Ministry of Water and Irrigation has the staff capacity, resources, and authority to develop and enforce sector plans and water budgets.
<b>Objective 1.6:</b> Strengthen water sector capital investment planning and management capacity to improve and institutionalize responsibilities for financial and water security assets	Centralize capital investment planning, in close coordination with utility business planning and donors, while simultaneously strengthening management capacity for capital investment projects across all responsible entities.

**Table 5: Pillar Goal (2): Restore balance between available water supplies and water demand**

<b>Pillar Goal 2: Restore balance between available and sustainable water supplies and water demand to sufficiently meet Jordan's health and economic development needs to achieve lasting water security</b> Indicator/Target: Water demand – supply balance is maintained from 2030	
Objectives	Indicators/Targets
<b>Objective 2.1:</b> Manage renewable water resources as holistic national water supplies with groundwater abstraction constrained to safe yield levels with controlling illegal abstraction and surface water is protected from illegal use and contamination to protect Jordan's declining water resources and ensure lasting water supplies.	Raw water supplies are managed centrally with efficient transfers between governorates to convey available water supplies to high demand areas as needed. Uniform enforcement of abstraction limits. Groundwater abstraction achieves safe yield by 2035. Elimination of all illegal surface water use and contamination by 2030.
<b>Objective 2.2:</b> Improve water sector planning, water supply policy determinations with respect to water supply needs, and water supply allocations for bulk water supplies and the annual water budget to eliminate the water supply deficit and achieve sustainable water supply allocations.	The Ministry of Water and Irrigation has accurate groundwater abstraction figures and safe yield analysis. National water allocations (municipal per capita determinations, irrigation quantities, etc.) are set based on availability of sustainable supplies aligned to socioeconomic priorities. Annual water budget per use is fair, matched to resource availability, reflects public policy, and is effectively monitored and enforced from 2026 by MWI.
<b>Objective 2.3:</b> Invest in developing additional sustainable supplies, including large-scale seawater desalination, expanding reclaimed water supplies, and accessing regional transboundary water resources to eliminate the deficit between growing demand and declining freshwater supplies.	Increasing diversity in sustainable water supplies, and relying on resources within the Jordanian national sovereignty, that make up for decreasing groundwater and surface water availability along with climate change variability in renewable water resources. These include large-scale desalination projects such as the National Conveyance Project producing 300 MCM a year, deep groundwater more utilized as possible, and accessing regional transboundary water sources with bulk transmission to demand centers by 2030. Wastewater treatment optimized to produce reclaimed water suitable for full allocation to productive uses.
<b>Objective 2.4:</b> Strengthen water use efficiency across all uses and with all consumers including public, agriculture, industry, business, and households to make the most of every drop of Jordan's scarce water resources and share national responsibility for water security.	Continuously improved levels of water use efficiency practices across all Jordanian households, public and businesses. Growing adoption of on-site water harvesting, wastewater treatment, and reuse practices within different businesses. Effective partnerships with high water-consuming businesses to lower overall consumption and pioneer water-saving practices.

**Table 6: Pillar Goal (3): Achieve financial sustainability**

<b>Pillar Goal 3: Achieve financial sustainability for water sector operations through the balance of full cost recovery and continued government support in critical infrastructure investment and pro-poor protections for water security</b> Indicator/Target: Revenues equal the cost of operations and maintenance and BOT capital charges for all water and sanitation services, and provision of national government budgets to achieve capital investment levels and sector subsidies needed to expand water production, networks, and treatment	
Objectives	Indicators/Targets
<b>Objective 3.1:</b> Increase revenues across the water sector through management and operational efficiencies and cost-reflective pricing restructuring that corresponds to improved services to improve cost recovery and to minimize the impact on the national debt.	Accurate calculation of the full cost of water production, transmission, treatment, and retail service delivery is available. Achieving cost recovery for operations and maintenance and Build Operate Transfer (BOT) charges through water tariffs restructuring.
<b>Objective 3.2:</b> Maximize the financial and economic return and efficient management of donor support	Donor coordination is tied directly to capital investment planning, in coordination with the Ministry of Planning and

to effectively target investment at critical infrastructure and sector development needs.	International Cooperation, to reduce the time to develop and complete donor projects. Target donor support at non-revenue water reduction and network improvements that improve cost recovery, protect, or improve water supplies, or expand critical services.
<b>Objective 3.3:</b> Expand, attract, and effectively manage private sector investment to help meet critical infrastructure and sector development needs.	Jordan provides an enabling environment, incentives, responsive governance of PPP and PSP arrangements, risk management, and legal and regulatory compliance that attracts private sector investment to sector development.
<b>Objective 3.4:</b> Set and allocate national budget levels that effectively reflect subsidies needed for the water sector and sufficient government investment in water security and essential services.	Financial budget allocations, and revenues from all water entities, add up to reach break-even for water sector operations from 2030.
<b>Objective 3.5:</b> Develop and regularly review and update appropriate pro-poor mechanisms to protect the most vulnerable households from the rising costs of water and wastewater services.	Water tariffs include coordinated and regulated government and utility protection measures for the poorest households to ensure that basic water and wastewater services are maintained.

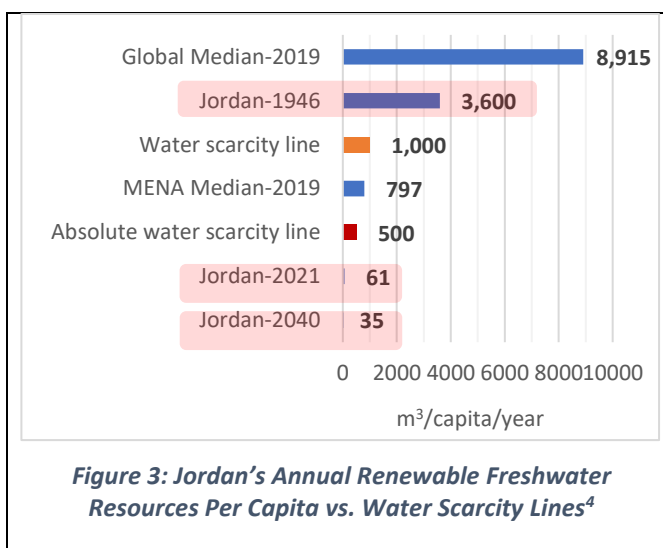
**Table 7: Pillar Goal (4): Ensure impartial and transparent regulation**

<b>Pillar Goal 4: Ensure impartial and transparent regulation of water sector services and costs</b> Indicator/Target: Independent regulator is established separate from the Ministry of Water and Irrigation authority that produces timely, high quality, accurate regulatory reports on water and sanitation services performance and costs	
<b>Objectives</b>	<b>Indicators/Targets</b>
<b>Objective 4.1:</b> Performance of water and wastewater services is effectively and independently regulated to ensure to the public and responsible government authorities that costs for services are reasonable and operators are accountable to their customers.	Law enacted to establish an independent regulatory body covering the water sector by 2025. The regulatory body has the staff capacity, resources, and authority to develop transparent, timely and accurate public reporting of water and wastewater services, financial performance, and legal compliance from 2026.
<b>Objective 4.2:</b> Service delivery performance is independently monitored and verified with reliable data measured against key performance indicators to hold utility companies accountable	Regular independent, accurate, and transparent water sector services performance report is issued at least semi-annually from 2026 and is simultaneously available to the public.
<b>Objective 4.3:</b> Regulatory reporting is fully integrated into sector planning and tariff setting to ensure transparency in setting consumer prices, improve financial performance, and deliver accurate water budgeting to serve water sector objectives.	Accurate performance data is used by the regulator to analyze and calculate the full cost of water production, transmission, treatment, and retail service delivery. Tariff recommendations are provided based on accurate costs of water. Reliable water production and water loss data is used in MWI planning and water budget development.
<b>Objective 4.4:</b> Build and sustain public trust in the quality, efficiency, and fairness of water and wastewater services and tariffs through reliable public regulatory reporting to reassure the public that utility companies and government authorities are responsive and responsible to their needs while making people aware of the real cost of services to households and businesses.	Regulatory reports are published and available to the public. Consultations with public and key sector stakeholders are held to present and discuss report findings and validate against people's lived experience with water and wastewater services, prices, and accountability for any mismanagement.

### 3 ACHIEVING A SUSTAINABLE BALANCE BETWEEN SUPPLY AND DEMAND

#### Current Situation

The water sector in Jordan has been facing a tremendous challenge in bridging the widening gap between demand for water and available supplies. Demand is continuously increasing due to population growth and the periodic influx of refugees fleeing instability in some neighboring countries. Demand is also increasing for economic development activities and continuous pressure to expand agricultural areas. Total water uses from all resources were about 1,093 MCM in 2021, including groundwater, surface water, reclaimed water, and desalination. The average total renewable freshwater resources available was about 680 MCM which is equivalent to only 61 m<sup>3</sup> per capita for all purposes in 2021, in addition to around 167 MCM of reclaimed water and less than 1 MCM of desalinated seawater. This puts Jordan as one of the poorest countries in terms of conventional renewable available water resources, which does not include reclaimed water and desalinated seawater), and by far below the absolute water scarcity level at 500 m<sup>3</sup> per capita and the Middle East and North Africa (MENA) median for 2019 at about 800 m<sup>3</sup> per capita as illustrated in Figure 3. However, due to the increase of the Jordan's population and the reduction of the available surface and groundwater in 2040, the annual renewable water resources per capita will reach to only 35 m<sup>3</sup> despite the significant increase of reclaimed water excluding desalinated water. If Jordan needs to reach the absolute water scarcity level in 2021, then its total water resources should be 5.5 billion cubic meters, which is eight times the currently conventional renewable available water resources, or five times the total water quantity used from all resources.



**Groundwater** contributes more than half of the annual water budget in Jordan<sup>5</sup> but is rapidly depleting. Overall groundwater supplies totaled about 619 MCM in 2021. Of this quantity, about 450 MCM was abstracted mostly from renewable aquifers and about 169 MCM annually from non-renewable resources in the Disi and Jafer Basins. The estimated safe yield, that is considered as the level safe, stable, and sustainable abstraction from renewable groundwater can be done, is about 280 MCM annually.

**Surface water** consists of the baseflows of wadis and springs as well as runoff including the transboundary water received from Tiberias and Yarmouk River. Dams are the main structure used to store and utilize surface water. There are 13 main dams constructed on the main wadis with a total storage capacity of about 280 MCM (Excluding Karamah Dam's capacity and not considering all sediment accumulation). Sediment accumulation in dams is a major challenge that continues reducing the storage capacity of the dams. Storage capacity lost in four major dams since construction constitutes 39 MCM or 27% of original capacity<sup>6</sup>. Sediment accumulation in dams will continue impeding surface water use unless sediment removal programs are implemented. For example, in 2020, the dams received only 30% of their total capacity due to diminished rainfall.

<sup>4</sup> MWI calculation, and FAO/AQUASTAT (2020) Global Information System on Water and Agriculture. Web: <http://www.fao.org/aquastat/en/>

<sup>5</sup> MWI (2021) National Water Budget

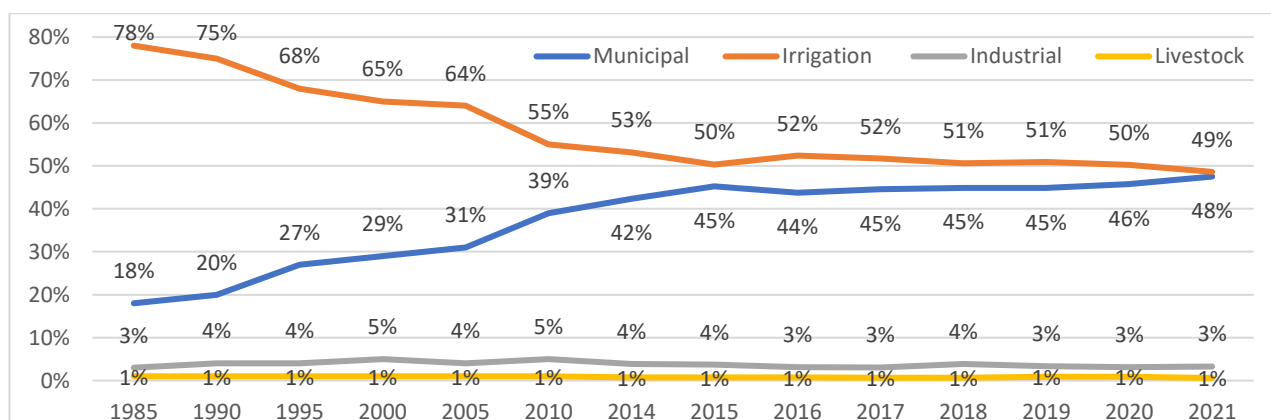
<sup>6</sup> GIZ & MWI, Third National Water Master Plan, Volume B, Annex B-3, 2022



Small quantities of water collected in dams are used for domestic purposes after treatment, while most of it is used for irrigation, with some quantities that are mixed with treated wastewater effluent and only used for irrigation purposes. The total surface water used in 2021 reached around 307 MCM, compared with about 470 MCM of total discharge of surface water that includes transboundary water, which is equivalent to 65% utilization of all surface water. A considerable portion of the surface water is of high salinity that is desalinated and treated before supplying it.

**Unconventional resources** consist of reclaimed water (treated wastewater) from 32 wastewater treatment plants (WWTPs) along with small-scale desalination plants of brackish groundwater and seawater, providing about 220 MCM in 2021. The reclaimed water quantities that are used directly and indirectly are about 167 MCM from a total WWTP capacity of 225 MCM. The brackish groundwater and surface water quantities in 2021 were 53 MCM, whereas the seawater desalination quantities in Aqaba were about 1.2 MCM of which 0.7 MCM supplied to Aqaba area and the rest is used by the fertilizer industry.

Jordan's different sectors are all competing for this limited supply from declining resources. While demand is increasing rapidly, water resources are becoming even more limited. Figure 4 shows water used by each of the economic sectors up to 2021 (MWI annual water budgets). Higher priority is always given to municipal water supply as it relates to survival and human well-being. Municipal water consumption has increased continuously over the years and by more than 23% over 2011-2021, at a time where water for agricultural activities decreased slightly to 49% in 2021 instead of 55% in 2010.



**Figure 4: Historic Pattern of Water Use by Sector**

MWI used remote sensing techniques to estimate actual irrigation water use by farming activities during 2017-2019, which was found to be higher by 24% to 28% of total registered irrigation water quantities used from all resources because of illegal water use, equivalent to around 145 MCM/year. As well, the illegal groundwater used for irrigation is estimated to be at least 40% of the recorded figures.

Different consumption sectors rely on different water resources. The **irrigation sector** is the highest water consumer at over 56% of total water supplies; in 2021, 39% of irrigation water came from groundwater, 30% from surface water, and 31% from reclaimed water. **Municipal water** is the second highest consuming sector and is heavily dependent on groundwater resources which make up more than 70% of the total supply for drinking water, while surface water makes up to 27%, and less than 1% currently comes from seawater desalination in Aqaba. Of the total supplies allocated to the **industrial sector**, almost 80% came from groundwater, about 12% from surface water, 9% from reclaimed water, and less than 1% from desalination of seawater<sup>7</sup> (see Figure 5).

<sup>7</sup> MWI 2021 Annual Water Budget

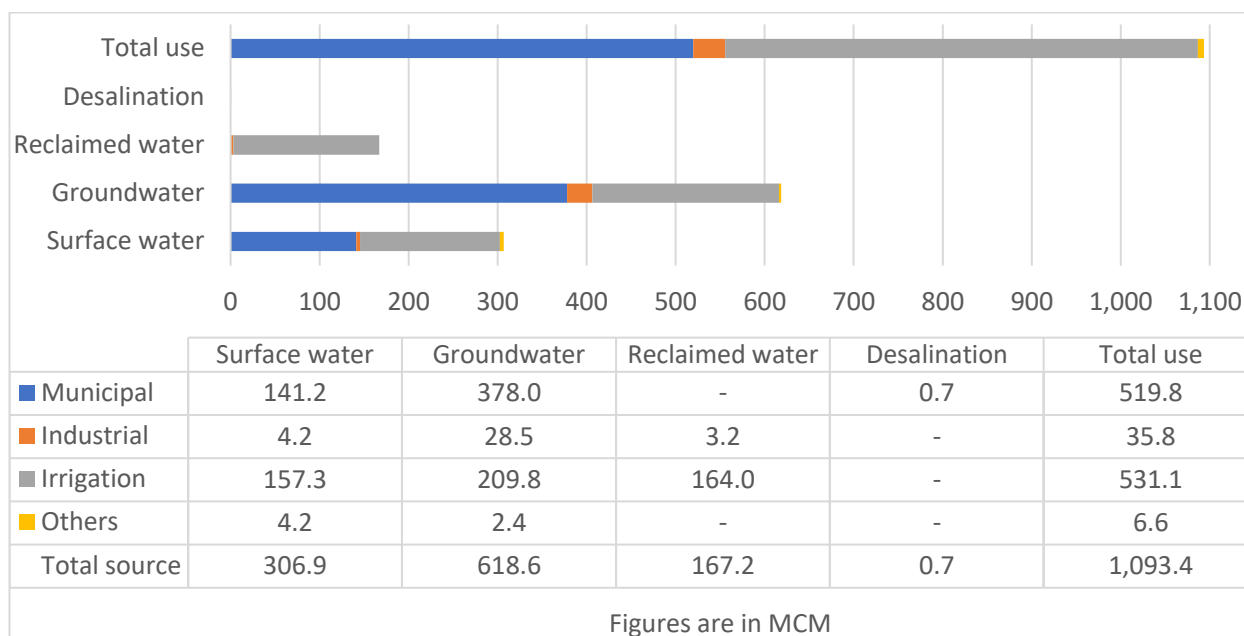
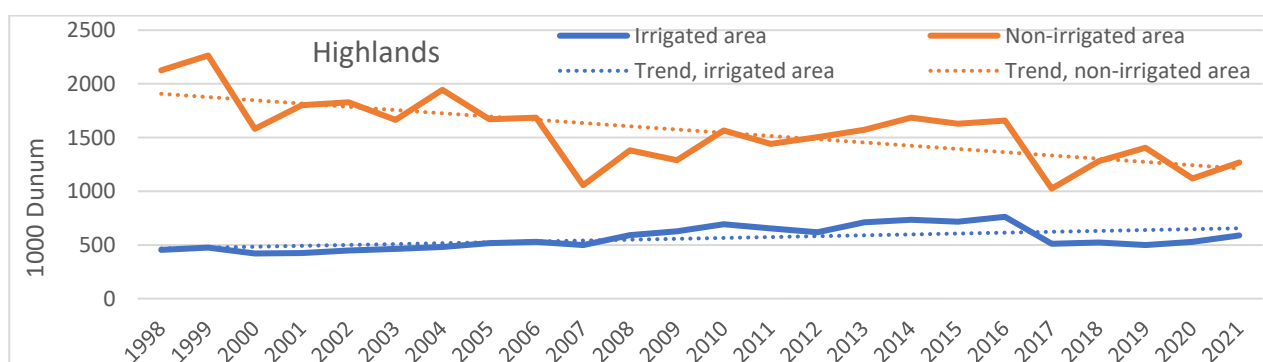


Figure 5: Water Use by Source and Sector in 2021

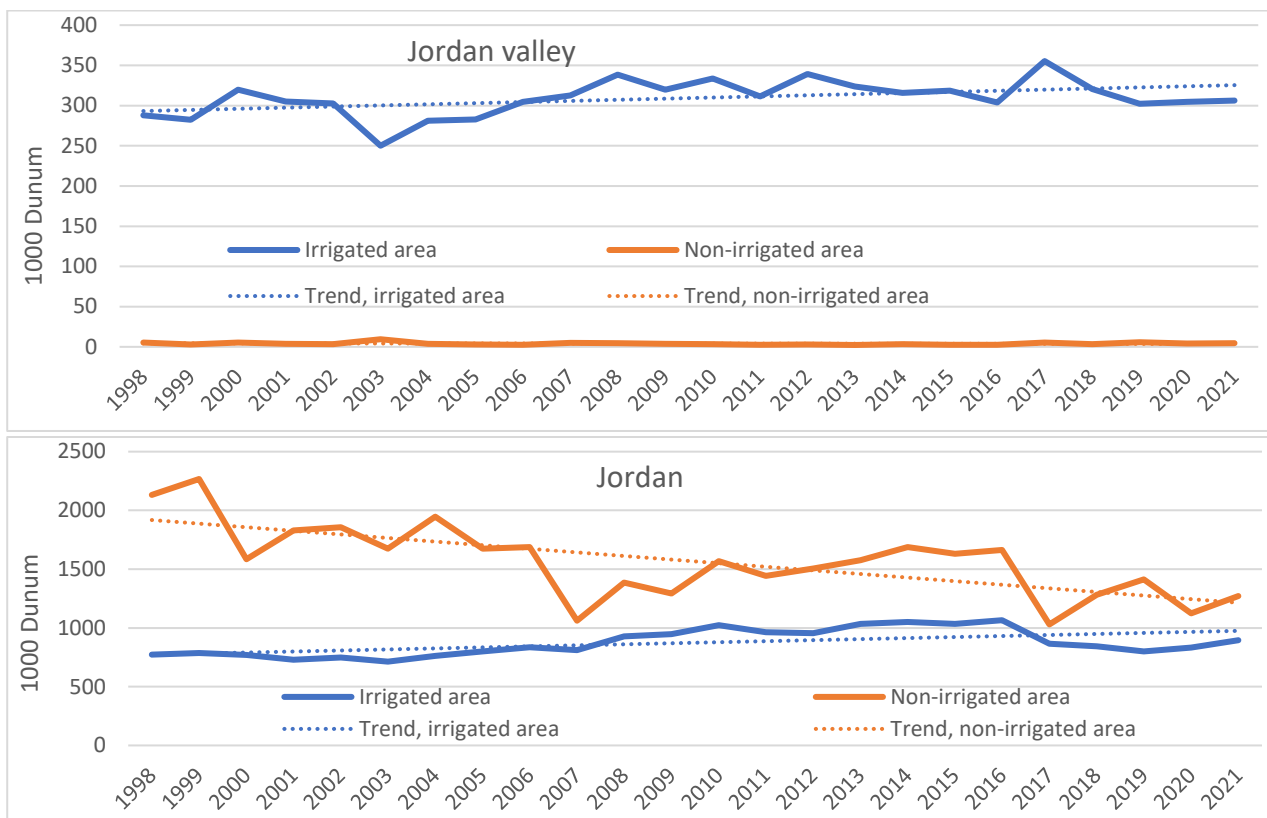
## Key Challenges, Considerations, Opportunities, and Threats

Meeting increasing demand across all uses, coupled with limited resources, has always been a challenge to Jordan's water sector, and the gap between available water supplies is now rapidly widening, particularly for municipal water, affected by some of the following main factors:

- **Population growth.** Jordan is reported to be among the world's top five growing populations<sup>8</sup>, almost tripling its population from 3.6 million in 1990 to 11 million in 2021 as reported by the Department of Statistics (DOS). Further, Jordan is expected to continue to have a high population growth rate, reaching about 17 million by 2040. This large population surge was the result of several refugee influxes plus high natural population growth. This level of growth has major implications on demand in all areas of drinking water, industry, and agriculture.
- **Agricultural expansion.** Irrigated land under cultivation in Jordan has boomed, with a very large surge in the 1980s and steady year-on-year expansion, particularly in the highlands, as illustrated in Figure 6. Historical rain feed lands have decreased due to urbanization leading to moving towards irrigation practices in highlands, which placed significant stress on already limited water resources. Bearing in mind that there is a discrepancy in the rainfall rate in some high areas with associated overexploitation of groundwater.



<sup>8</sup> UNICEF (2020), Drying Up Their Futures: The Impact of Water Scarcity on Children in The MENA Region.



**Figure 6: Agricultural Area Changes 1998-2021 (DOS, 2022)**

- **Limited water resources availability.** Jordan is classified as one of the most water scarce countries in the world with internally renewable freshwater resources of around 61 m<sup>3</sup> per capita per annum. Jordan's low rainfall levels mean that 92% of the country is considered arid to semi-arid, receiving less than 200 mm of rainfall annually.
- **Declining exploitability of water resources.** Groundwater levels are declining strongly in recent years<sup>9</sup>. Thus, the areas in which aquifers can be exploited are shrinking and exploitability is continuously shifting further east. Strong groundwater level decline in the west leads to the mobilization of brackish water from the east toward currently used wellfields. Salinities are therefore increasing in many currently exploited wellfields and desalination will be required in many areas in the future.
- **Transboundary waters.** Around a quarter of Jordan's renewable water resources originate from outside its territory<sup>10</sup>. Jordan has limited control of this supply, which is impacted by the actions of other countries.
- **Climate change.** Jordan is facing a clear trend of reduced annual rainfall and increasing summer temperatures that are responsible for less water availability while also spiking demand in hotter summer months. Based on current climate change effects (reduced precipitation and increasing temperatures), impacts on water resources were determined in the Third National Water Master Plan (NWMP-3)<sup>11</sup> based on UNFCCC (2014). Accordingly, annual groundwater recharge and surface water runoff are estimated to decrease by 15% by 2040, i.e., groundwater recharge will be only 240 MCM/yr., while surface water discharge quantity (excluding transboundary water) will be only 340 MCM/yr.

<sup>9</sup> GIZ & MWI, Third National Water Master Plan, Rapid Assessment, 2020 and Volume B, 2022

<sup>10</sup> FAO. [2017]. AQUASTAT Core Database. Food and Agriculture Organization of the United Nations. Web: <http://www.fao.org/aquastat/en/>.

<sup>11</sup> GIZ & MWI, Third National Water Master Plan, Rapid Assessment, 2020 and Volume B, 2022

Despite these many challenges, there are some opportunities for the water sector to improve the situation and achieve the national strategy goals, as well as threats that need to be considered, as shown in

Table 8.

**Table 8: Water Sector Opportunities and Threats**

Opportunities	Threats
Current national bulk water infrastructure is sufficient which gives Jordan the ability to manage effectively the bulk water supplies and distributing it to high demand centers and improving equitable water allocations across the country.	Additional investment is needed to expand and upgrade the current bulk system to reach changing demand centers in the future. Illegal uses and vandalism are a risk to the system and increase water losses.
Continued expansion of sewer services and wastewater treatment plant capacity has generated increasing quantities of reclaimed water available for reuse in irrigation and industrial uses to replace freshwater supplies.	Quality of reclaimed water varies in some plants which limits reuse options. WWTPs are not always located where there is demand for reclaimed water and distribution networks are still limited. Social acceptance for use of reclaimed water still needs to be expanded.
Jordan has under-exploited brackish water resources in the order of 37 MCM/yr, where the operational cost of desalinating such water can reach below 0.3 JD/m <sup>3</sup> .	Handling brine water resulting from the desalination process could be a challenge and a limiting factor due to the difficulties and cost of disposing the brine water. Also, the presence of harmful elements in brackish water will increase the cost of treatment.
Seawater desalination is a valuable source to significantly increase drinking water supplies to meet demand and provide relief to over-exploited groundwater resources that can instead be restored as strategic reserves for future generations.	Desalination of red sea water in Aqaba is expensive with high investment and running costs to build and operate treatment plants with significant added costs for piping and pumping desalinated water to demand centers in the middle and north of the country.
Jordan understands water scarcity. Demand management plans are in place accompanied by efforts such as public awareness campaigns, introduction of water saving technologies, practices for households to conserve municipal water, and water harvesting practices.	Current water tariffs are too low to be an effective incentive to conserve and harvest water and reduce demand. Intermittent supply limits the effectiveness of some water-saving devices and appliances. Customs and market barriers exist for importing water efficient appliances.
Private sector participation has proven to be effective in improving the efficiency of water operations and to develop and operate advanced infrastructure effectively and efficiently, through contracting opportunities to reduce NRW to the minimal possible, creating supply from existing resources that would otherwise be lost due to leakage or illegal use.	Risks allocation and management for PSP is critical to ensure successful partnerships. The current limited capacity in managing PSP projects in the water sector resulted from the brain drain and hiring challenges, which must be addressed. Lack of a third party to regulate the relationship with the private and public sector increases the reluctance for more PSP in water sector activities particularly those that are performance based.

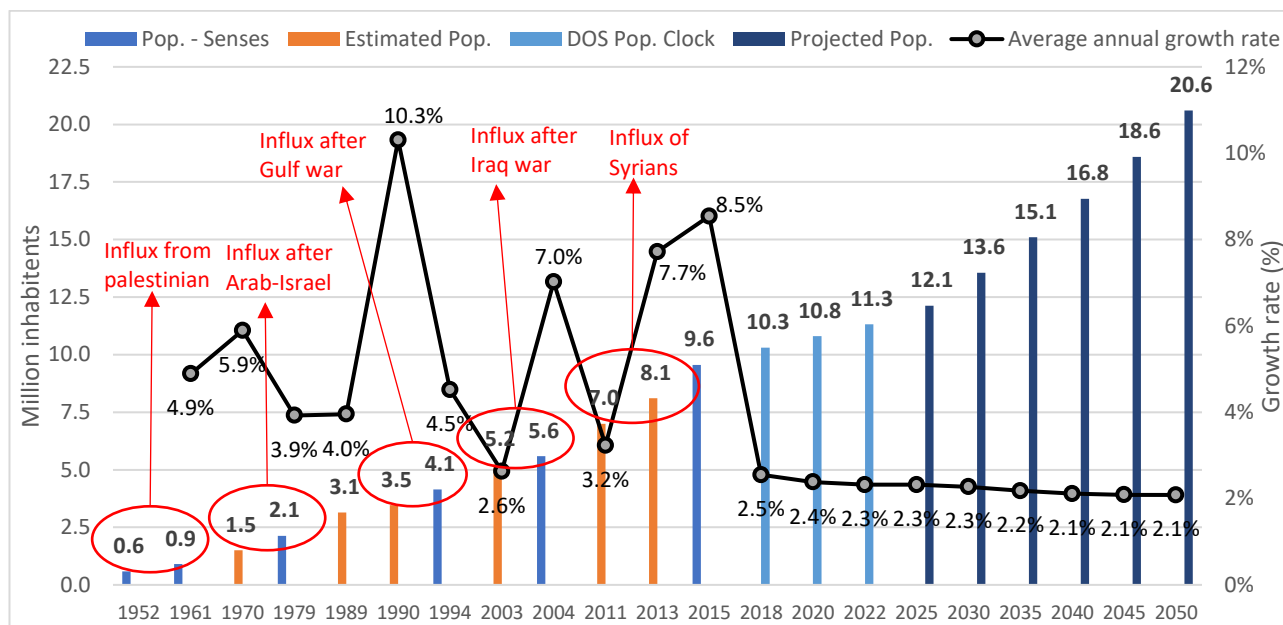
## Future Water Demand

### Municipal Sector Demand

Municipal demand is defined as the supplies needed to provide sufficient drinking water quantities for all uses. To achieve water security, meeting municipal demand is the highest priority in developing water allocation budgets. Municipal water demand is calculated based on the estimated per capita water demand for domestic use and number of population, and by adding the non-domestic demand quantities, and then estimates for physical losses is added up to calculate the total needed annual water supply. On top of this, seasonal demand is accounted for to ensure that summer demand surges can be met, so that there is sufficient capacity in the water resources and systems to meet municipal demand during the peak period.

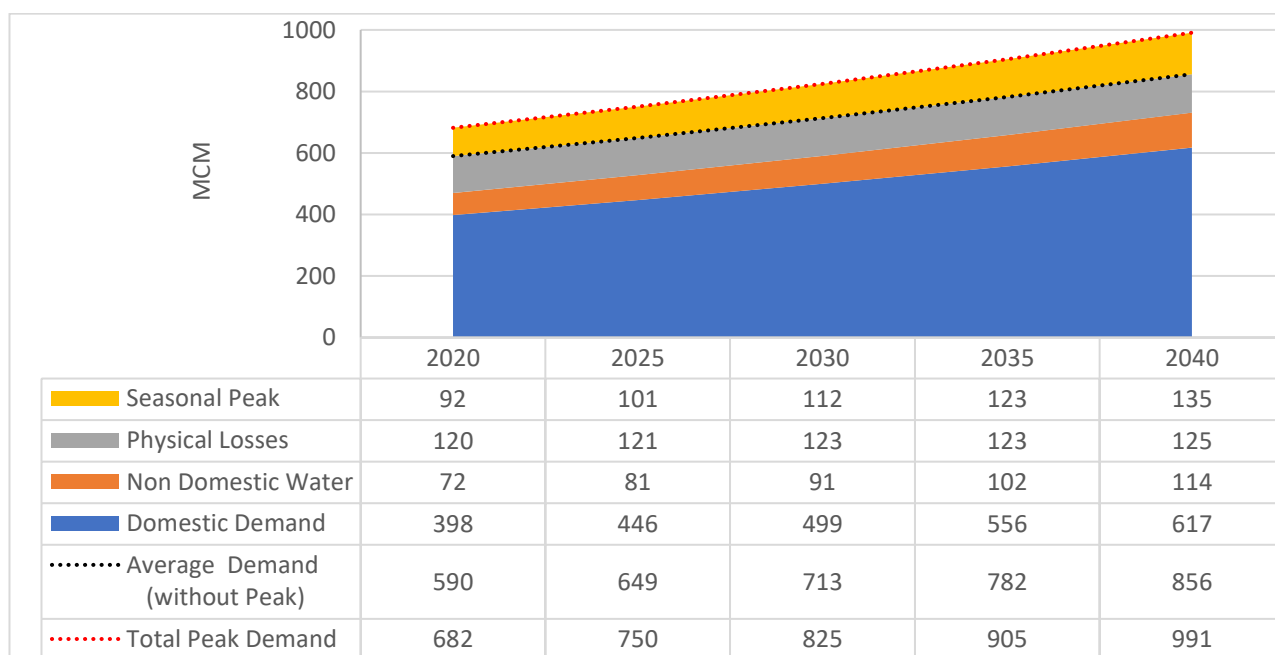
Historically, population growth was high and reached up to 10% in some years due to population influxes from regional countries and high natural population growth as illustrated in Figure 7. The Ministry of Water

and Irrigation (MWI) estimated the future population based on the latest population figures as reported by DOS and adjusted high growth scenario, where Jordan's total population is expected to reach around 16.8 million and 20.6 million by 2040 and 2050 respectively as shown in the Figure 8 below.



**Figure 7: Jordan's Historical and Projection Population and Regional Influxes**

Based on the projected population and the demand parameters explained above, the municipal water demand quantities through 2040 are estimated as summarized in Figure 8. The seasonal peak demand (during May to August) is the additional water supply requirement and system capacity needed to meet the demand during the high consumption period of the year.



**Figure 8: Municipal Water Demand Projection**

### Irrigation (Agricultural) Sector Demand

Irrigation water demand is determined by actual consumption based on customers meters and estimates based on total area under cultivation and crop-water requirements. The NWMP-3 has projected irrigation

water demand which is illustrated in Figure 9. The irrigation water demand is estimated for the Jordan Valley (JV) and the highlands. Demand in the JV is considered stable as the total available land area for farming does not change over time and is around 371,000 dunums. The estimated average annual water demand in the JV is around 371 MCM per year. With adding the physical water losses in the JV estimated at 18 MCM in 2040, the total water supply requirement is calculated at 389 MCM as illustrated in the figure below. On the other hand, the projection for the highlands was based on analyzing historical trends and current consumption utilizing water sector records and a remote sensing assessment to validate current consumption levels. The study estimated the expansion of irrigated areas in the highlands based on water availability, land availability, groundwater availability, soil salinization, and changes in cropping patterns.

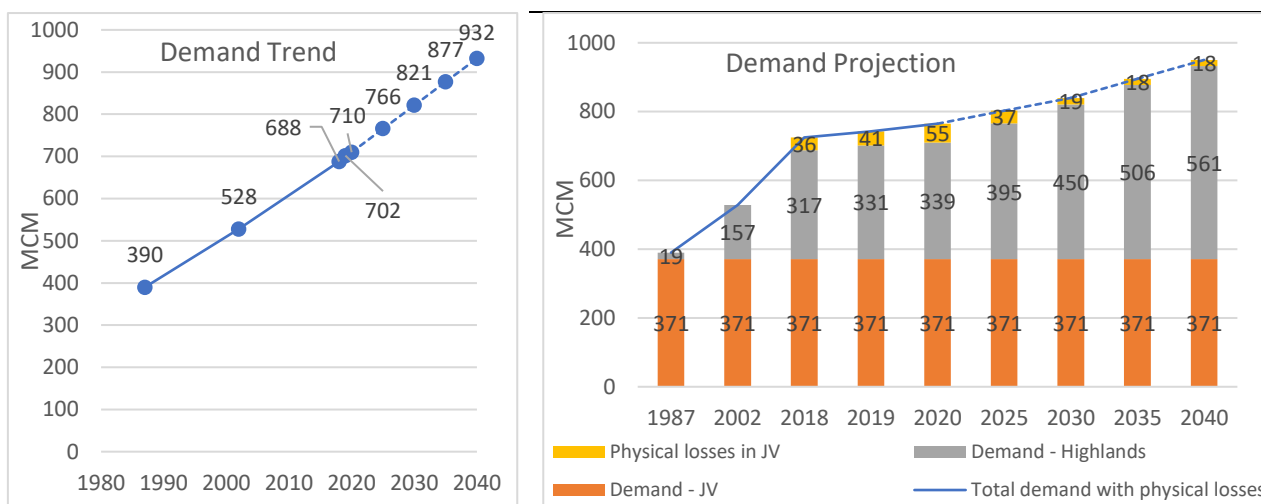


Figure 9: Current Water Use and Projected Water Requirement for Irrigation (NWMP-3, 2021)

## Industrial Sector Demand

Most industries rely on groundwater through privately licensed wells that are monitored by WAJ. The only interaction between the water sector and the industrial sector is through these licensed wells. There is also coordination between the JVA and the potash and bromine industries for oversight of surface water in Southern Ghor. There is limited utilization of reclaimed or small-scale desalination water in industry, and this is limited to the Aqaba area. The 2021 NWMP-3, Volume C, Annex C-3 has projected industrial demand by around 72 MCM by 2040 based on a simple trend analysis and assumption of a percentage increase. Planned expansions and new projects were also taken into consideration to come up with projected demands as shown in Figure 10.

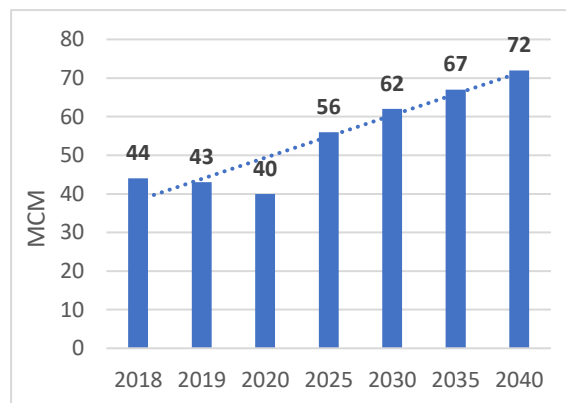
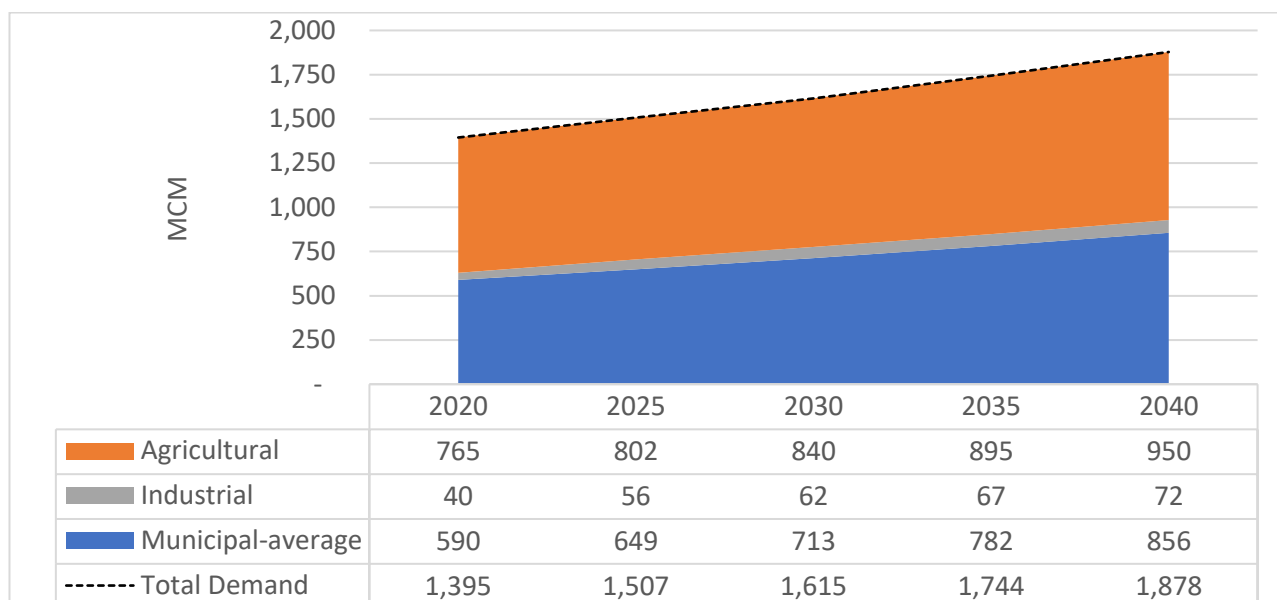


Figure 10: Current Water Use and Projected Demand for Industrial Sector (NWMP-3, 2021)

## Overall Demand Summary

Figure 11 summarizes the projected overall water demand through 2040, which will increase by around 35% between 2021 and 2040, where the municipal sector will reach around 46% of overall water demand by 2040.





**Figure 11: Projected Water Demand for All Sectors**

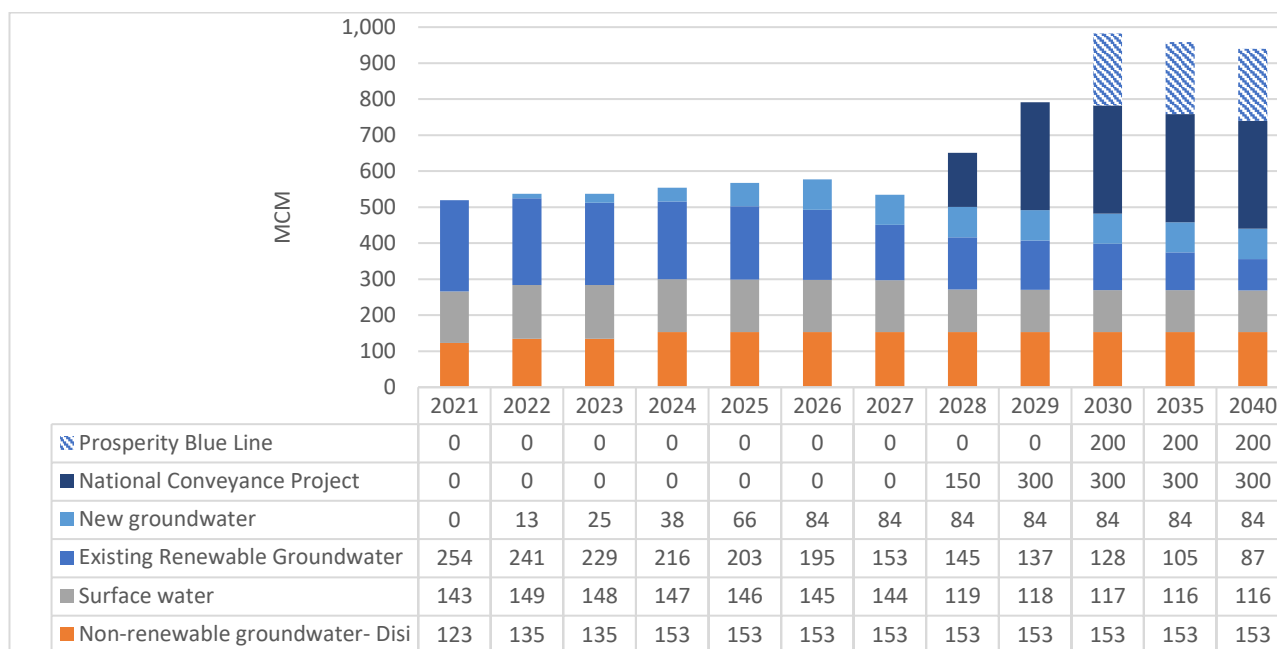
## Future Water Supplies

### Municipal Sector

To assess the supply-demand gap, analysis of existing supplies is done in combination with those planned with projects already in the pipeline. Existing municipal water supplies include water resources extracted from wells, springs, and purified surface water. Figure 12 includes a summary of projected water resources in Jordan up to 2040, with the National Conveyance Project (NCP), which will desalinate water in Aqaba and deliver an additional 300 MCM capacity, expected to come online by around mid-2028. Additionally, there are other new water resources being developed including the Hisban brackish and East Aqeb Basalt well fields, local wells, deep groundwater well fields, and scattered surface water sources of very small amounts.

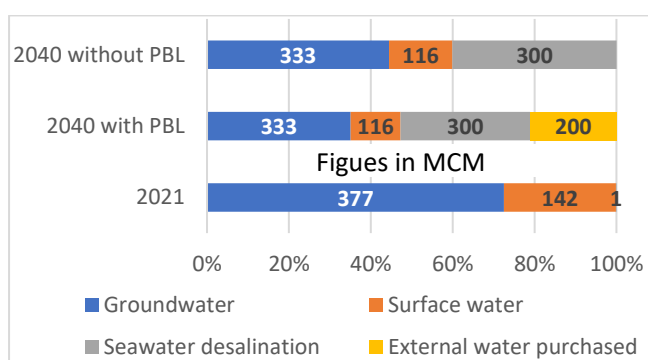
Renewable groundwater resources are expected to steadily decline based on current analysis and historical trends, with 2021 quantities at around 256 MCM (including purchase from private wells at 43 MCM). These resources are expected to reach their lowest level by the time of operating the NCP.

Additionally, Jordan is cooperating with regional countries to bring additional water resources through working together to meet climate change challenges on water and energy security. This cooperation is expected to bring around 200 MCM by 2030 through the Prosperity Blue Line (PBL) which, with the NCP, will allow Jordan to both further reduce the over-abstraction of groundwater resources and assist in sustaining them.



**Figure 12: Current and Future Available Water Resources for Municipal Sector**

Due to anticipated new resources, the contribution of groundwater resources in municipal water will decrease from about 73% in 2021 to around 44% in 2040. Most new resources will come from desalinated sea water, contributing around 40% of water supplies in 2040, and is expected to continue growing as no other major resources are left for utilization in Jordan as illustrated in Figure 13.

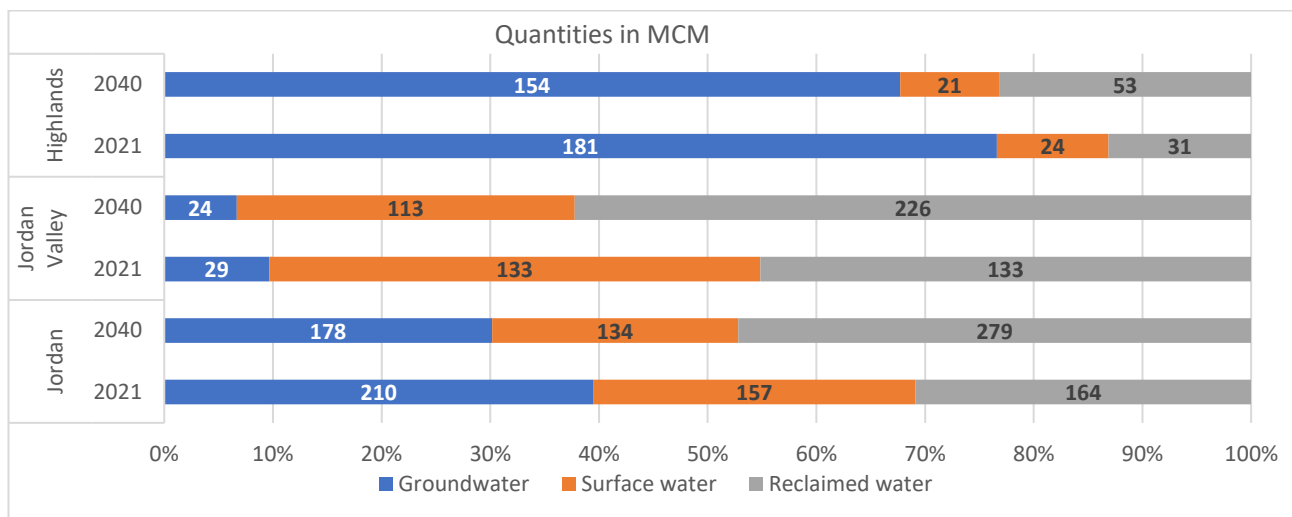


**Figure 13: Current and Future of Water Resources for Municipal Sector (in MCM)**

## Irrigation Sector

Progressively over recent years, the irrigation sector is nearly equally reliant on groundwater (39%), surface water (30%), and reclaimed water (31%), according to 2021 figures. Nonetheless, groundwater is the major source of irrigation water in the highlands which contribute more than three-quarters of total fresh and quality water resources. On the other hand, JV relies almost equally on surface and reclaimed water at around 45% each in 2021 as illustrated in Figure 14.

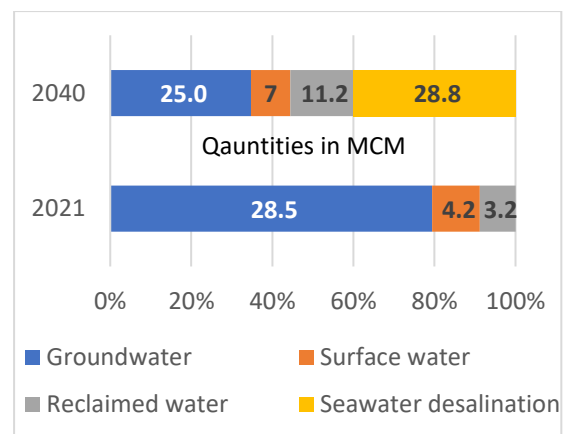
By 2040, surface water is expected to decline by around 15% due to climate change (NWMP-3, 2021), at a time when the quantities of treated water are increasing because of the expansion of sanitation services in all regions of the Kingdom and the increasing use of municipal water. It is also expected that quantity and quality of groundwater used for irrigation will deteriorate because of the over-abstraction and the illegal wells drilling. By 2040, around half of future water resources for irrigation will come from reclaimed water as shown in Figure 14.



**Figure 14: Current and Future Water Resources for Irrigation (in MCM)**

## Industrial Sector

The industrial sector, specifically heavy industry, which is not served by the municipal water network, has always heavily depended on groundwater resources (representing around 80% of industrial water supplies in 2021). The remaining resources include surface water and small amounts of reclaimed water. It is unanticipated that industry will be able to continue using the same quantities of groundwater in the future, this is due to the declining groundwater levels and reliability on currently available surface water is also declining due to climate change (Third National Water Master Plan, Volume C, 2021). Future water resources to meet industrial sector demand will come mainly from recycling industrial water to the extent possible and from seawater desalination and reclaimed water as illustrated in Figure 15.

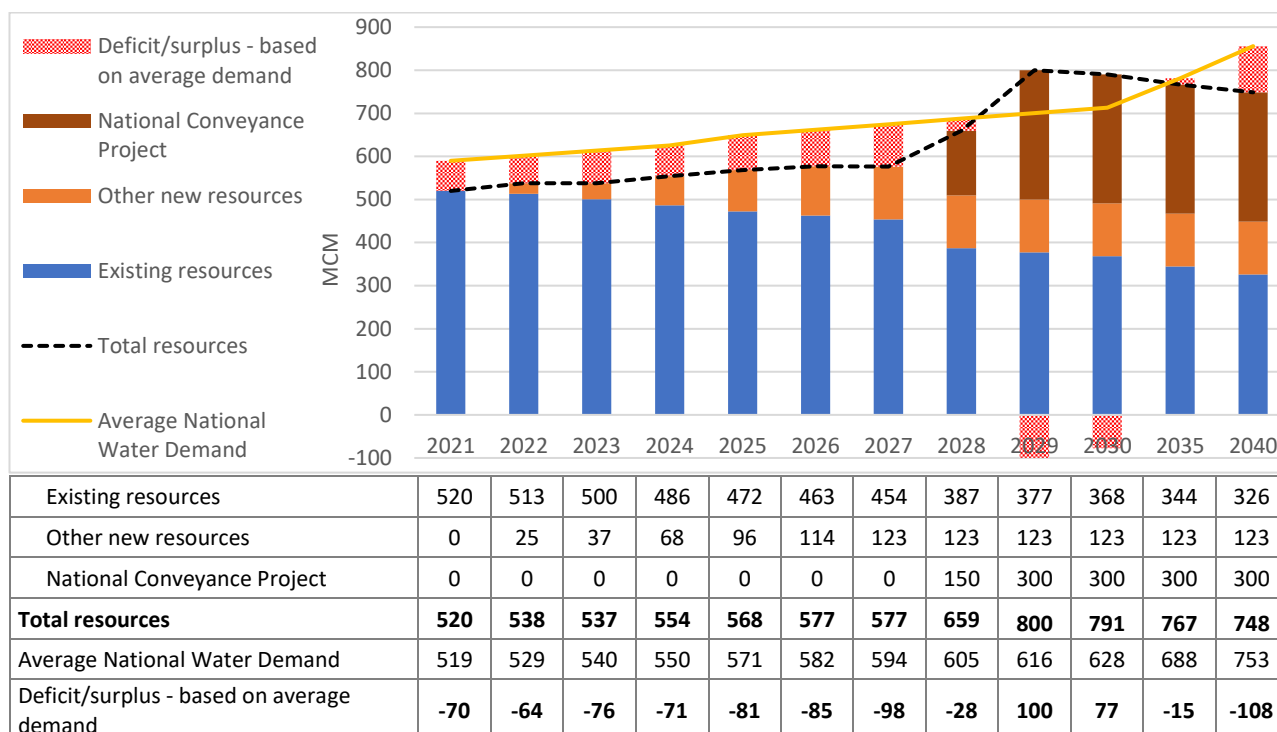


**Figure 15: Current and Future Water Resources for Industrial Sector (in MCM)**

## Water Demand-Supply Deficit

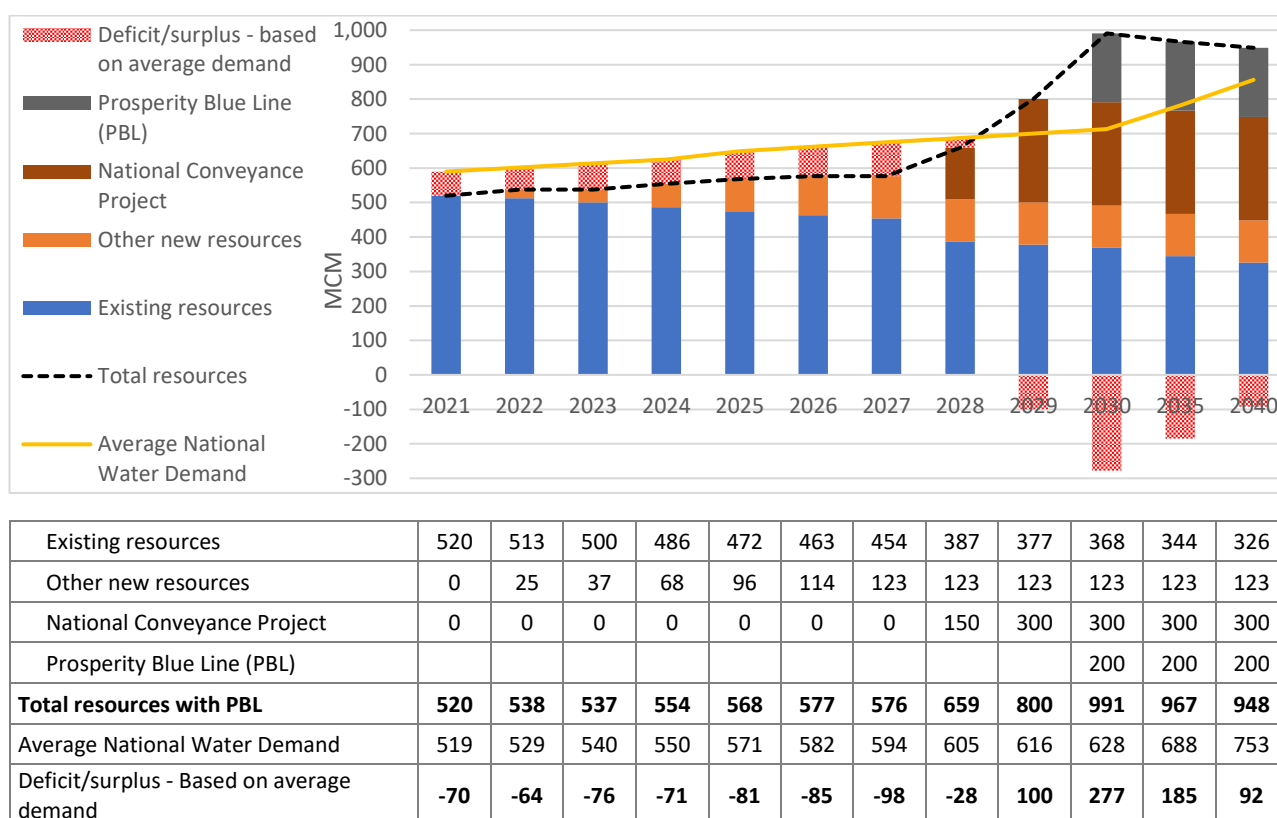
### Municipal Sector

The new resources anticipated, including the NCP, will reduce the demand-supply deficit until 2035. After that time, however, water supply is again anticipated to go into increasing deficit reaching more than 100 MCM annually by 2040, as illustrated in Figure 16. Therefore, the search for additional water resources, like establishing additional desalination plants like the NCP will be needed before 2040 to fulfill water needs of the growing population and the development requirements. It will be essential to continue exerting all efforts to increase demand management efficiency by improving water use practices and by minimizing water losses throughout the water systems.



**Figure 16: Water Demand-Supply Deficit for Municipal Sector**

With regional cooperation that may bring an additional 200 MCM by 2030 through the Prosperity Blue Line (water for energy), which is anticipated to fill the water deficit beyond 2040 as illustrated in Figure 17. Such situation will allow a reduction in the current over-abstraction from groundwater resources and giving it the chance to recover and recharge its storage, thus availing surface water for irrigation in the Jordan Valley and for other economic activities.



**Figure 17: Water Demand-Supply Deficit for Municipal Sector considering water quantities from PBL**

## Irrigation Sector

The major water deficit in the irrigation sector is anticipated to reach around 364 MCM/year by 2040 formulating around 38% of the total irrigation water demand. And when the NCP is operationalized, increasing municipal water consumption, will provide additional treated wastewater for irrigation, and deficit will be focused mainly in the highlands and reduced in Jordan Valley, as illustrated in Figure 18. Prior to the NCP, the overall water deficit will continue to grow, and the agricultural sector will be under increased stress particularly as climate change leads to less rainfall and increased fluctuation in rain frequency. Nonetheless, this overall water deficit will urgently need to be managed with some structural changes to the agricultural sector in terms of water allocation for irrigating low consumption crops to increase its economic value, and enhance efficient irrigation practices, particularly in the highlands.

The recent remote sensing studies conducted by MWI show that the actual groundwater abstraction for irrigation purposes is higher than the metered records by around 140 MCM/yr., which means that the irrigation water deficit in 2021 is around 94 MCM, not 234 MCM (See Water Resources Management and Monitoring under the IWRM chapter).

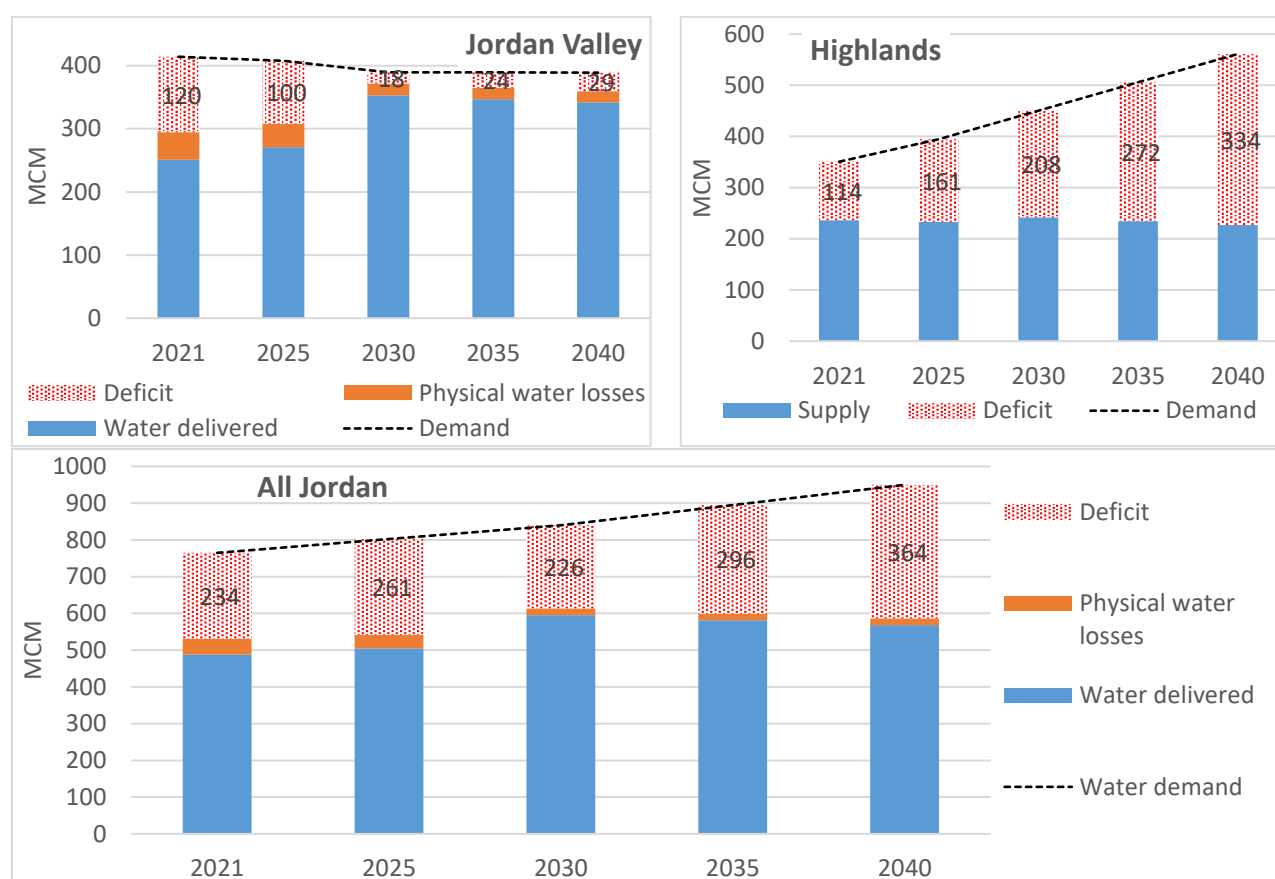
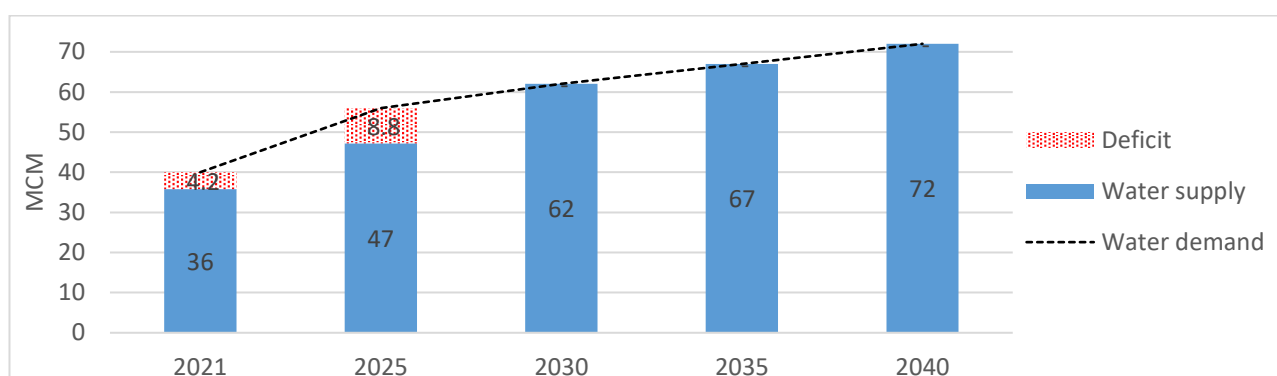


Figure 18: Water Demand-Supply Deficit for Irrigation Sector

## Industrial Sector

The deficit in the industrial sector is anticipated to be reduced to zero after the NCP comes into operation and sufficient desalinated water will be provided to the industries, as shown in Figure 19 below.



**Figure 19: Water Demand-Supply Deficit for Industrial Sector**

## Goal 1: Provide Sufficient and Sustainable Municipal Water Supplies to Meet Water Demand Allocation Policy Equitably across All Governorates

The goal of providing sufficient and sustainable municipal water supplies reflects that Jordan's need relies in determining, delivering and distributing available water quantities in a way that meets international standards for the per capita supply, recognizing sustainability of these supplies now and for future generations so that not all country's resources are consumed and depleted. To achieve the balance needed for a lasting water security, the sector needs to manage the sustainability of the systems of governance, infrastructure, and operations required to ensure that sufficient supplies are delivered as effectively and efficiently as possible.

### Objectives

Goal 1: Provide sufficient and sustainable municipal water supplies to meet water demand allocation policy equitably across all governorates				
Indicator/Target: Close the gap between water supply and demand in all governorates by 2030 and sustain it				
Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 1.1:</b> Reduce Non-Revenue Water (NRW) across municipal water systems (see Utility Management and Services chapter, Goal 2)	NRW strategy implemented and national target of 25% NRW in all water systems achieved	52%	25%	2040
<b>Objective 1.2:</b> Increase the amount of non-conventional water resources contributing to municipal water supplies	Volume of desalinated sea water for municipal water supply (MCM)	1	300	2028
	Volume of desalinated brackish water for municipal water supply (MCM)	53	TBD	Ongoing
	Volume of reclaimed water for municipal water use (MCM) <sup>12</sup>	<1	TBD	Ongoing
<b>Objective 1.3:</b> Strengthen the management of bulk water as a national system to optimize any needed transfer of water between governorates to fairly and efficiently distribute water supply to demand centers	Water supplies are managed in a holistic system that links water production, treatment and transmission to distribution and supply networks as efficiently as possible, including across governorates			Ongoing

<sup>12</sup> This is mainly used for landscaping purposes



<b>Objective 1.4:</b> Improve the sustainable utilization of surface water for municipal water use	Improved sustainability and reliability of surface water quality supplied for municipal water	2030
<b>Objective 1.5:</b> Responsibly develop water resources, including viable groundwater resources, based on regular and reliable hydrological and environmental analysis	Ongoing investigation and development of sustainable groundwater, viable fossil aquifers, brackish water, and other alternative supplies where appropriate and environmentally responsible	Ongoing

## Strategic Approach

**Reducing water losses from leakage and illegal use.** Physical water loss that can be recovered is a major source of water to fulfill water deficit. The NWS addressed the water losses for municipal water systems under the utility management and service strategic area (Chapter 5) and for irrigation water systems under the irrigated agriculture strategic area (Chapter 06).

**Secure new water resources, including large-scale desalination.** As existing groundwater needs to be restored and surface water resources become less reliable, the water sector will continue to assess and secure additional viable water supplies. These efforts need to be in parallel with efforts to improve management and allocation. Sediment management and removal programs in dams will help to restore some of the previous surface water storage capacities or at least save the current storage levels. NCP development and sea water desalination will be the largest new water resource and will contribute to bridging the gap between demand and supply. The sector will explore any new resources to utilize for water supply including deep fossil waters, brackish groundwater, and any other alternatives, including coordination with neighboring countries to secure additional water supplies and enhance transboundary water management.

**Develop bulk water systems' capacity.** Bulk water supply systems require continuous expansion and upgrading to facilitate water allocation between different sectors and governorates. With the NCP development, water supplies will be increasing in desalination facilities in Aqaba. This water should be efficiently transferred throughout the country, calling for restructuring of WAJ and JVA in order to develop bulk water management capacities through deploying technologies in monitoring and control of the national carrier and integrated water supplies from surface and groundwaters.

**Improve national water systems to deliver water effectively and continuously.** The highest national priority remains to supply municipal water while simultaneously ensuring sufficient water for key economic activities to the greatest extent possible without jeopardizing water resources sustainability and long-term water security. This means ensuring sufficient water allocations are also for agricultural activities to maintain the socioeconomic development of the country and for industrial activities which contribute to workforce development and overall economic growth. With the increase in the gap between the demanded water quantities and the available ones, there is an urgent need for coupling allocation programs with the agricultural sector and industry stakeholders to improve water use efficiency and increase the value and productivity of every drop of water used in agricultural and industrial activities. The annual water budget based on the available water resources and water allocation plan will be developed to ensure fair water distribution among the water demand centers.

**Protect water resources from illegal use, overuse, and contamination.** An area that needs greater attention is to improve the protection of water sources from contamination, pollution, and illegal use. This is essential to ensure sustainability and continuity of supply. This requires developing and implementing groundwater protection zones, protect surface water from dumping of pollutants or untreated wastewater, increase efficiency and specifications of wastewater treatment and prevent illegal activities and use affecting all groundwater and surface water systems as well as bulk water transmission systems.

**Expand reuse of reclaimed water in different sectors.** Reclaimed water is a particularly valuable resource for Jordan as a critical tool in combating scarcity by replacing declining freshwater resources used in agriculture and industry. The sector will continue to expand sewer systems and invest in wastewater treatment to improve its quality within international standards to increase the volumes of treated effluent that is safe for reuse in a variety of ways. This expansion is possible because Jordan's growing population generates correspondingly growing volumes of wastewater if it is effectively captured by service coverage of sewer systems to convey it to the WWTPs.

## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
WAJ	<ul style="list-style-type: none"> <li>- Develop national allocation plans and updated national bulk water infrastructure plans to enable cross-governorate water allocation and distribution</li> <li>- Manage executing the capital investment for water system restructuring</li> <li>- Implement illegal use campaigns, in coordination with utilities, Ministry of Interior (Mol), and other concerned parties</li> <li>- Increase penalties on illegal use</li> <li>- Secure additional water supplies on a national level</li> </ul>
MWI	<ul style="list-style-type: none"> <li>- Consolidate nationwide capital investment plan</li> <li>- Lead transboundary water coordination</li> <li>- Assess progression of groundwater resources decline</li> <li>- Participate in exploration of new additional water resources, including groundwater, through studies and drilling projects</li> <li>- Participate in implementing water protection zones and allocation plans for domestic and irrigation uses</li> </ul>
JVA	<ul style="list-style-type: none"> <li>- Implement sediment management and removal programs in dams</li> <li>- Develop national irrigation water allocation plans and expand bulk water capacity</li> <li>- Implement surface water protection</li> <li>- Increase efficiency of surface water supply</li> <li>- Reduce water losses in irrigation systems</li> </ul>
Water Companies	<ul style="list-style-type: none"> <li>- Improve wastewater treatment quality, as needed, and reclaimed water distribution</li> <li>- Implement water safety plans</li> <li>- Delineate groundwater protection zones for springs and wells used for drinking water supply and enforce related protection measures</li> <li>- Reduce water losses in municipal water distribution systems</li> </ul>
Mol	<ul style="list-style-type: none"> <li>- Empower campaigns to control illegal water use and train relevant water sector staff</li> </ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
Qualified personnel to undertake needed national allocation and capital investment planning, O&M mandates, and water source protection measures	Investment in bulk water infrastructure expansion and linkages, efficiency improvements, and wastewater treatment	Robust and consistent enforcement of regulations and legal limits for water abstraction and use and wastewater disposal along with increased penalties for illegal use

## Goal 2: Reform Irrigation Practices by Reducing the Amount from Freshwater Resources Used to Irrigate Crops While Increasing Total Water Allocations and Value from Non-conventional Sources and More Efficient Irrigation

The country is confronting the reality that there are no longer enough freshwater resources, including water needs for irrigation, forcing the water sector to find a way to continue to provide irrigation water and reduce the overall volumes of freshwater. This will mean a concerted effort to continue expanding the search for non-conventional water, such as treated wastewater, to replace freshwater. Simultaneously, the water sector and agriculture sector need to work closely to increase efficiency across all agricultural production through approaches such as more efficient irrigation systems and practices, switching to crops that require less water, and expanding innovative production practices like hydroponics.

### Objectives

Goal 2: Reform irrigation practices by reducing the amount from freshwater resources used to irrigate crops, and replace it with non-conventional sources, while increasing total water allocations and value from non-conventional sources and more efficient irrigation				
Indicator/Target: Total volume of freshwater used in irrigation is steadily reduced				
Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 2.1:</b> Continue to increase the use of non-conventional water resources in irrigation to reduce freshwater supplies used while increasing total quantities available for irrigation	Volume of freshwater used in irrigation (MCM/Y)	367 <sup>13</sup>	307	2040
	Volume of substitute water sources for irrigation (MCM/Y)	0	60	2040
<b>Objective 2.2:</b> Reduce water losses in irrigation transmission and distribution systems in JV (see Irrigated Agricultural, Goal 2)	Reduce water losses from leakage, illegal use, and billing and metering inefficiency to less than 25 MCM by 2030			
<b>Objective 2.3:</b> Maximize the use of reclaimed water for agriculture (see Irrigated Agricultural, Goal 3)	Amount of total agricultural land irrigated by reclaimed water (MCM/Y)	164	~279	2040
<b>Objective 2.4:</b> Control over-abstraction of groundwater used for irrigation (see IWRM and Environmental Protection, Goal 1)	Restore irrigation water abstraction to safe yield levels through improved groundwater management and enforcement of well licenses and act upon illegally drilled wells			2035

### Strategic Approach

Achieving this goal requires the combined commitment and actions between all partners, including the water sector, agricultural sector, farmers, agri-businesses, Water Users Associations, local leaders, water utilities, government authorities, and key stakeholders. The main strategic approaches for the water sector to enable the success of this goal are presented below.

**Improve efficiency of irrigation systems.** Efficiency of irrigation systems from bulk water transmission through to farm-level distribution and operations needs to be increased and high levels of water loss needs to be reduced. The need to reduce water losses in the King Abdullah Canal (KAC) and the irrigation transmission and distribution systems that it operates are top priorities for JVA. The sector must work with farmers and agri-businesses to identify on-farm irrigation inefficiencies and provide information on water productivity as well as the latest options and innovations for improved techniques and technologies.

<sup>13</sup> This figure represents the registered usage. However, MWI and GIZ estimated that around 140 MCM of additional freshwater quantity is illegally used on an annual basis, either through illegal groundwater wells or illegal connections to water systems

**Commit to better reclaimed water quality and quantities.** To optimize reuse opportunities for irrigation, the sector will remain committed to the continued working on increasing wastewater quantities, expanding its treatment scope, and improving its quality according to international standards, so that recycled water becomes a viable replacement for freshwater. For this purpose, the sector will work on expanding wastewater systems and ensure that wastewater treatment facilities plan for seasonal loads and future expected loads as municipal water systems also continue to expand.

**Improve integrated water resources planning.** For the purpose of developing the water distribution plan and the annual water budget, the sector will develop and implement a National Surface Water Master Plan that integrates municipal water infrastructure planning. The sector will continue to conduct regular analyses and assessments to identify the most critically depleting groundwater aquifers, update safe yield studies for each of them, and develop comprehensive plans to steadily reduce abstractions while providing alternatives to users such as reclaimed water or other economic opportunities with less water needs.

**Cooperation and outreach to promote reclaimed water reuse.** The sector has a responsibility to communicate not only the need to optimize reclaimed water use but, more importantly, its benefits for the agriculture sector and national water security. Formal and informal cooperation with the agricultural sector officials and stakeholders must expand to jointly explore options and promote reclaimed water reuse, identify shortcomings, and agreement on solutions, particularly in the highlands. The sector will also promote all appropriate techniques and technologies to improve on-farm irrigation efficiency and rainwater harvesting so that farmers can also take control of water-saving approaches themselves. Improved coordination with JVA and farmers is also important to ensure TWW is accepted for reuse in agriculture and actual reuse is truly expanded.

**Review and update standards if needed to expand using reclaimed water.** Standards and regulations for reuse of treated wastewater effluent need to be continually updated to reflect the latest science and research on safe and productive uses that pose no risk to human health or environment.

## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
WAJ	<ul style="list-style-type: none"> <li>- Coordinate with JVA on irrigation water management to reduce freshwater supplies and accelerate replacement</li> <li>- Engage agricultural water users on improved irrigation techniques and technologies</li> </ul>
MWI	<ul style="list-style-type: none"> <li>- Development and implementation of communication and outreach programs on reuse</li> <li>- Identify and regularly assess critically depleting groundwater aquifers to prioritize reducing abstractions, update safe yield numbers for each groundwater aquifer, and implement projects and studies supporting this</li> <li>- Lead the water allocation plan development and participate in the surface water master plan</li> <li>- Act on illegal wells in coordination with MoI</li> </ul>
JVA	<ul style="list-style-type: none"> <li>- Develop national irrigation water allocation plans and national surface water master plans in coordination with WAJ</li> <li>- Increase efficiency of water transmission and distribution systems</li> <li>- Engage agricultural water users on improved irrigation techniques and technologies</li> </ul>
Water Companies	<ul style="list-style-type: none"> <li>- Improve wastewater treatment quality to expand volumes of safe reclaimed water</li> <li>- Comply with groundwater abstraction limits and protection measures</li> </ul>
MoA and NARC	<ul style="list-style-type: none"> <li>- Support review of reuse standards to optimize reclaimed water reuse for irrigation</li> <li>- Encourage and enforce continued replacement of groundwater with reclaimed water</li> </ul>

Human Resources	Financial Resources	Requirements
Sufficient personnel with qualifications to carry out planning and O&M mandates	Infrastructure investments to reduce system losses and increase wastewater treatment levels	Continued political will to protect dangerously depleted groundwater

## Goal 3: Increase Non-Conventional Water Resources Supplies for Industrial and Other Uses

The industrial sector is another key sector that can expand the utilization of water reuse. The sector currently consumes around 3% of the total water in Jordan but uses almost no reclaimed water despite several applications within the sector being suitable for reuse. The sector relies mainly on fresh groundwater resources, and industry provides another potential area in which the country can substitute reclaimed water and save fresh water for municipal use, and ultimately reduce over-abstraction.

### Objectives

Goal 3: Increase non-conventional water resources supplies for industrial and other uses Indicator/Target: Increase total volume of non-conventional water supplies used for industrial and other needs, such as on-site wastewater treatment, reuse, and water harvesting (see Utility Management and Services chapter, Goal 3)				
Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 3.1:</b> Increase reclaimed water used for industrial and other uses	Volume of reclaimed water used in industry and other sectors (MCM/Y)	3.2*	11	2040
<b>Objective 3.2:</b> Increase desalinated water used for industrial and other uses	Volume of desalinated sea water used in industry and other sectors (MCM/Y)	0.7*	29	2040
<b>Objective 3.3:</b> Increase harvested water used for industrial and other uses	Volume of harvested water used in industry and other sectors (MCM/Y)	0	TBD	2040

\* Source: MWI Annual Water Budget for 2021

### Strategic Approach

**Promote, expand, and incentivize local reuse and water harvesting.** Work with the industries and other potential users like road and building construction, mining, etc. to identify and introduce in-house reuse of wastewater in production. MWI will work in cooperation with the Ministry of Environment (MoEnv) and with the support of donors to conduct internal assessments of selected industries to demonstrate the economic feasibility and highlight the contribution to the national water scarcity and propose measures to maximize the reuse of wastewater as an input in the production process. Additionally, MWI will work with the chambers of industry and commerce and the municipalities to encourage water harvesting for industrial and other uses through enforcing the harvesting regulations.

**Review and update current groundwater bylaw and relevant regulations.** To correspond with the above priority shifts to reduced groundwater abstraction and increased recycled water use, relevant water legislation and regulations should be reviewed, updated, and modified, as needed, to accommodate industrial uses. Incentives for industry should be also explored and adopted as needed.

**Conduct a national assessment to identify potential industrial users and initiate water supply agreements.** The country needs a comprehensive assessment to consider the location of industrial users and the ways and processes in which water is used as well as requirements for quality and quantities. This needs to be matched against proximity to WWTPs to determine alignment with reclaimed water quality and quantities. An economic feasibility will be developed to examine the current cost of water and its relation to the

industrial product costs in each industry to determine and propose appropriate tariffs for recycled water. An improved coordination mechanism between MWI and the potential users is required. Supply agreements can then be developed with industries to put long-term purchase agreements in place.

## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
WAJ	<ul style="list-style-type: none"> <li>- Conduct national assessment of industrial uses and WWTPs in cooperation with utilities</li> <li>- Promote water harvesting for certain industries' use, in coordination with MWI</li> <li>- Review and update Groundwater Bylaw to promote reuse, in coordination with MWI</li> </ul>
MWI	- Develop economic analysis of reuse opportunities for different sectors including industry
JVA	- Coordinate with industries on utilizing surface water and water harvesting
Chamber of Industries	<ul style="list-style-type: none"> <li>- Initiate dialogue on reclaimed water use and water efficiency practices</li> <li>- Participate in Groundwater Bylaw review on development of incentives for reuse</li> </ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
Water sector entities staffed with qualified personnel to undertake planning mandates	Infrastructure investments to expand wastewater treatment and recycled water distribution	Economic incentives or cost savings for industry to adapt operations to use recycled water

## Monitoring and Evaluation

Goal 1 will be monitored by WAJ and its water utilities with support from MWI. The central operation directorate of WAJ will report on bulk water management and allocation between governorates and utilities. WAJ will coordinate with JVA on surface water use for municipal demands. The Central NRW Unit will lead oversight of utilities' NRW reduction plans and progress.

Goal 2 will be monitored primarily by JVA with support from WAJ. JVA Directorates will report on the following: amounts of fresh water used for irrigation, reclaimed water amounts used in JVA areas, KAC water losses, and progress on projects to reduce losses and optimize irrigation water transmission and distribution systems. The Basins Directorate will report on groundwater abstraction for irrigation and progress against illegal wells and over abstraction. WAJ and MWI will coordinate in the analysis of aquifer safe yields. The Reuse Directorate will report on amounts of reclaimed water used for agriculture.

Goal 3 will be monitored by WAJ and MWI. The Reuse Directorate and water companies will report volumes of reclaimed water used for industry uses. MWI will lead coordination efforts with the Chamber of Trade & Industry to promote reuse and rainwater harvesting and regularly report on progress.

## Conclusion

Achieving these goals is key to Jordan's water security. The country cannot afford to sustain a supply-demand deficit as the result will be irrevocable deterioration of national water supplies. These measures will not only halt declines but also restore groundwater resources while still meeting demand projections for lasting water security. This is vital for the continued economic growth of the country and the prosperity of all Jordanians.



## 4 INTEGRATED WATER RESOURCES MANAGEMENT (IWRM) AND ENVIRONMENTAL PROTECTION

Jordan's extreme water scarcity and growing demand on water and services require all the country's resources to be managed in a holistic and integrated way to maximize economic and social welfare in an equitable manner, with close attention paid to viability and protection for long-term sustainability. Details of the water institutions' management strategy for all water resources come to ensure sufficient water provision and maintain or restore its quality on the long term.

### Current Situation

#### Water Resources Management and Monitoring

The Strategy's chapter on Achieving a Sustainable Balance between Supply and Demand showed that groundwater is the most important source of water in Jordan, as it contributes more than half of the water used, as shown in Figure 20. Surface water comes as the second source of water, then treated wastewater, and finally desalination. Figure 21 summarizes Jordan's water resources over 2008-2021 where the extracted non-renewable groundwater quantities were doubled, and reclaimed water was increased by two third over this period. Surface water quantities were fluctuating despite increasing the number and storage of the dams and ranged between 239 MCM and 364 MCM due to the rainfall variation.

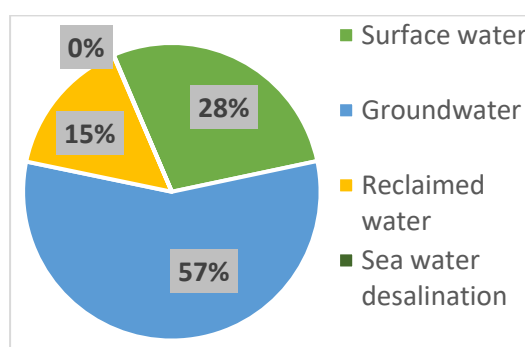


Figure 20: Water Source Shares in Jordan (2021)

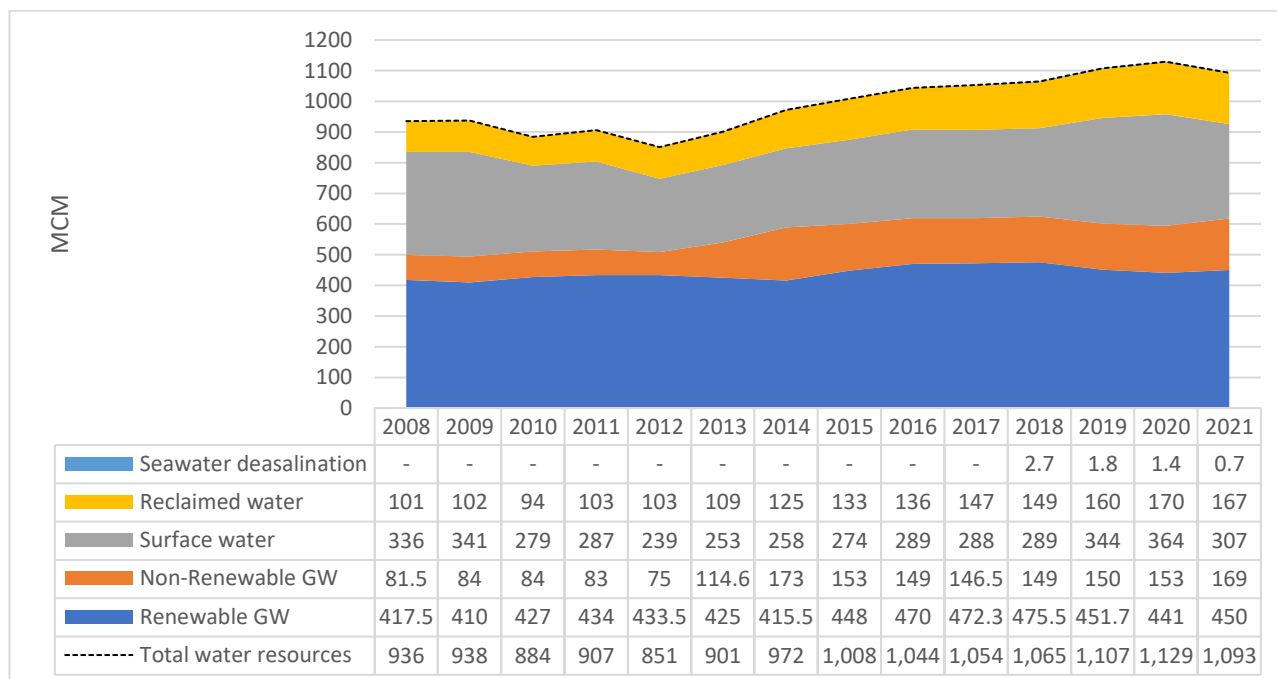
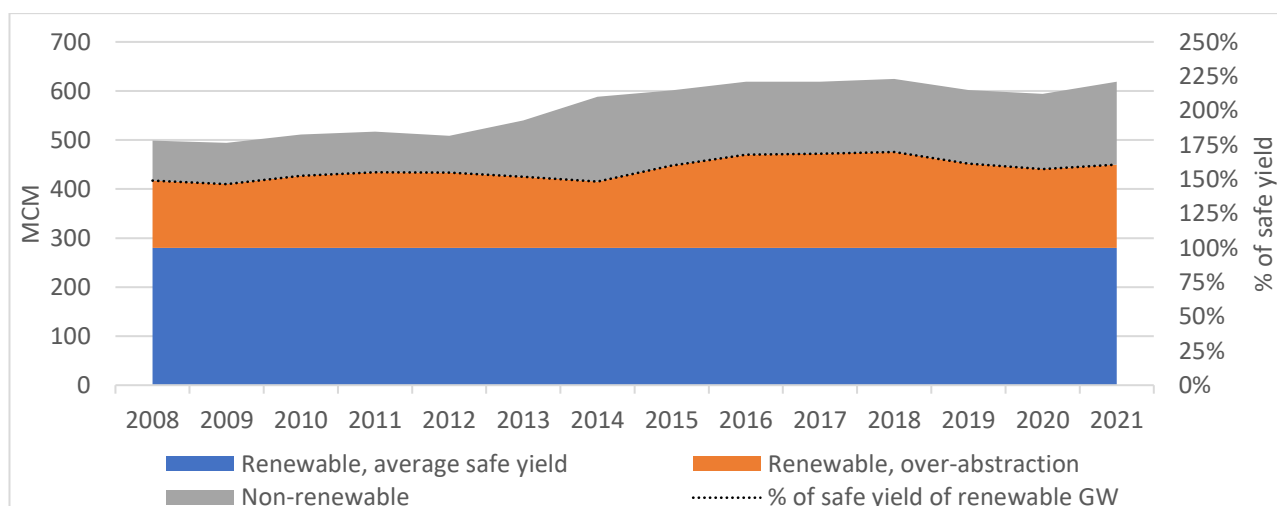


Figure 21: Water Resources in Jordan over 2008-2021 (MWI Annual Water Budget Reports)

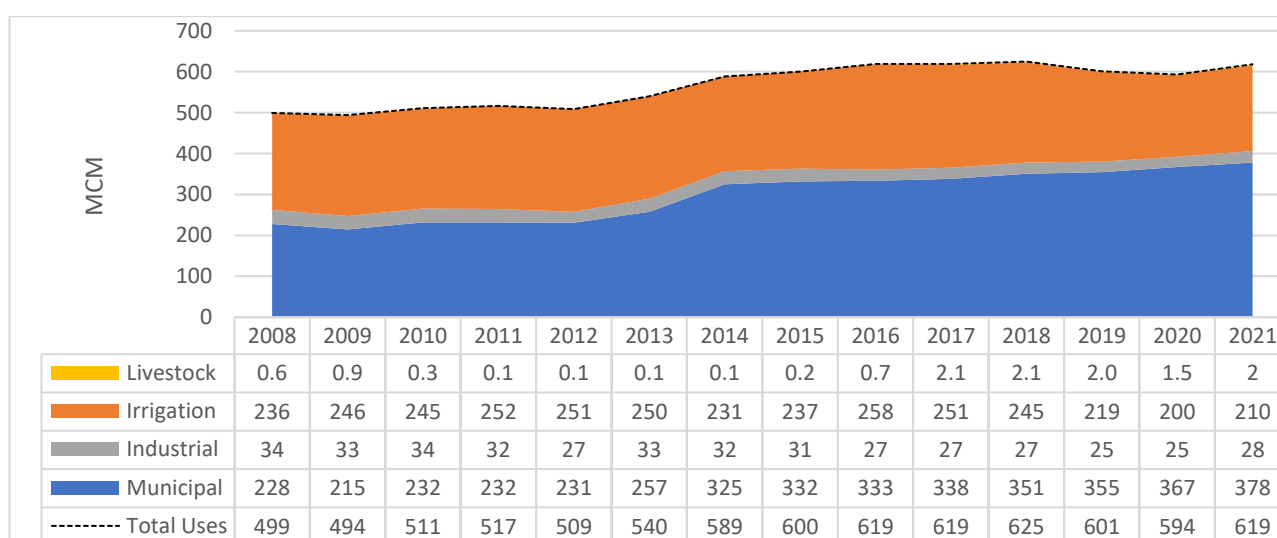
**Groundwater (GW)** is typically of high quality and prioritized as a drinking water source by the municipal sector. Figures of year (2021) show that 57% of Jordan's total water supply comes from groundwater, totaling 619 MCM of water supplied, which includes 169 MCM of non-renewable groundwater, resulting in the abstraction from renewable groundwater resources of 450 MCM. This is almost more than double the

groundwater average annual recharge rate or safe yield of 280 MCM, as shown in Figure 22. This causes average groundwater level declines of up to 10 m/yr. in some areas with 4-5 m/yr. in most other areas<sup>14</sup>.



**Figure 22: Renewable and Non-Renewable Groundwater Abstraction to Safe Yield (MWI Annual Budgets)**

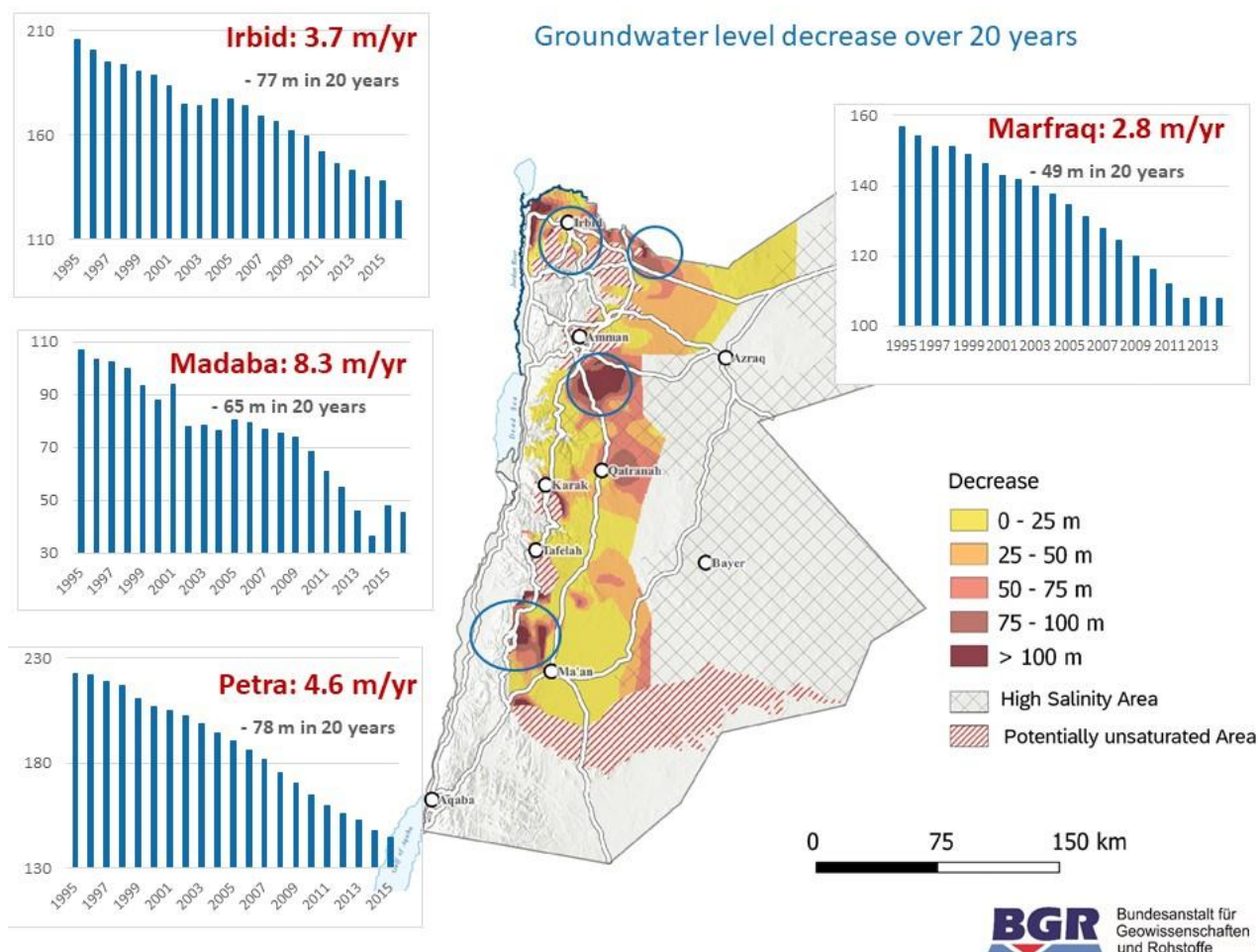
Figure 23 shows the changes in groundwater consumption pattern over the last 14 years. The increase in municipal use since 2014, is attributed to the operation of many resources, most importantly the Disi aquifer and transferring to Amman and other Governorates. Groundwater management is the responsibility of WAJ mandated to develop bulk water supplies, license and monitor private wells and abstraction quantities from them. The Groundwater Monitoring Bylaw was issued in 2002 to conserve and protect groundwater from illegal use and over abstraction has been in place since 2002. The 2002 Bylaw defined the duties of the competent authorities and amended licensing conditions and abstraction fees for private wells as well as the enforcement thereof. This was followed by a comprehensive groundwater sustainability policy approved in 2016 along with new regulations to manage Jordan Valley groundwater. An e-Groundwater Monitoring System and Telemetric Gauging stations platform were installed to feed into a National Water Information System (NWIS) which was initiated in 2016. A system for groundwater quality monitoring is also in the process of being established.



**Figure 23: Groundwater Use over 2008-2021 (MWI Annual Water Budget Reports)**

<sup>14</sup> Third National Water Master Plan (NWMP-3), Rapid Assessment, 2020

Due to the presence of some unlicensed wells and the illegal water use in agriculture, the actual groundwater use by the agricultural sector during the period 2017-2019 is estimated to be 40% higher and at around 100 MCM/yr (NWMP-3, 2020). As a result of this and groundwater over-abstraction practices, the groundwater level has shown steady decrease over the years as illustrated in Figure 24, where many areas exceeded the 100 m decline making these aquifers out of production or nearing out of production.

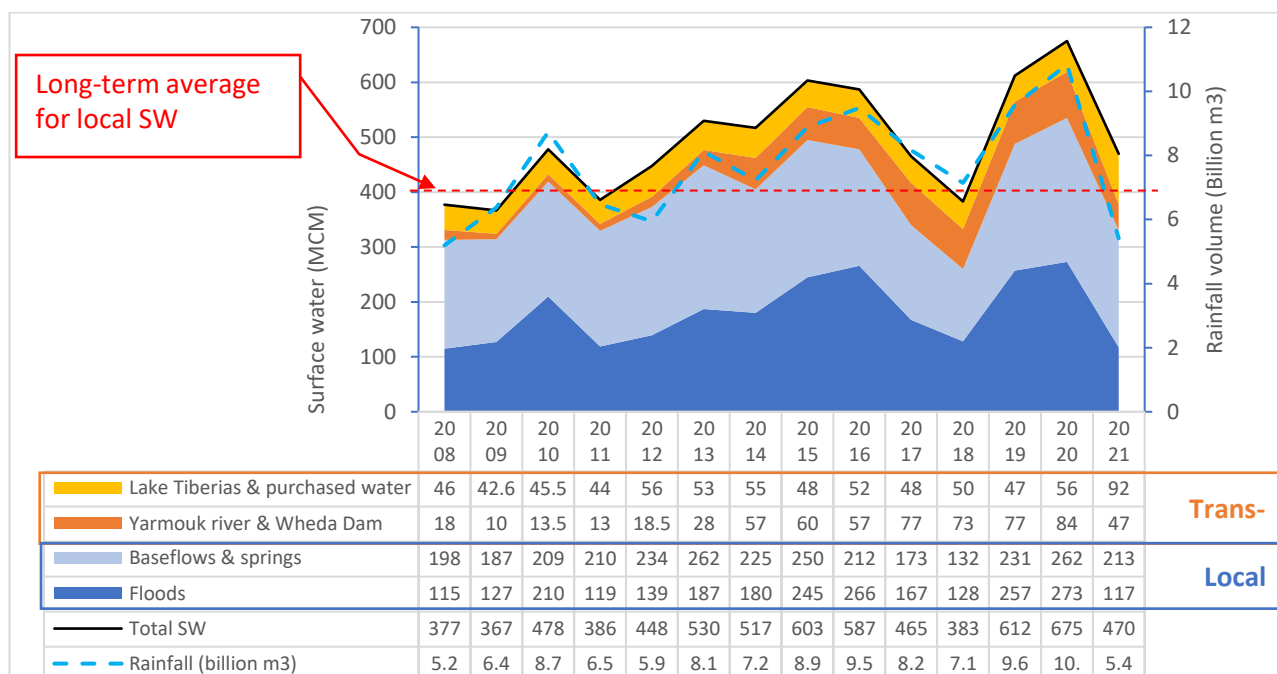


**Figure 24: Groundwater Level Decrease Between 1995 and 2017 (Source: BGR)**

**Surface Water (SW)** supplies provide approximately 28% of Jordan's total water used across all sectors with total developed local SW resources reaching 330 MCM in 2021 out of 470 MCM estimated SW discharge volume, including transboundary water. The difference is either not captured or lost (including evaporated).

SW is supplied from local surface water flows mainly base flows, spring, floods in the local streams and wadis and treated and recycled wastewater that is pumped in local water streams, which contributed to 70% of the total available surface water in 2021. The long-term average of local surface water discharge flows is estimated at 400 MCM. The transboundary flows mainly come from Yarmouk River (including Wehda dam), Jordan's water rights from Lake Tiberias, including the quantity of water that can be stored in the lake during flooding periods, and water purchased from neighboring countries.

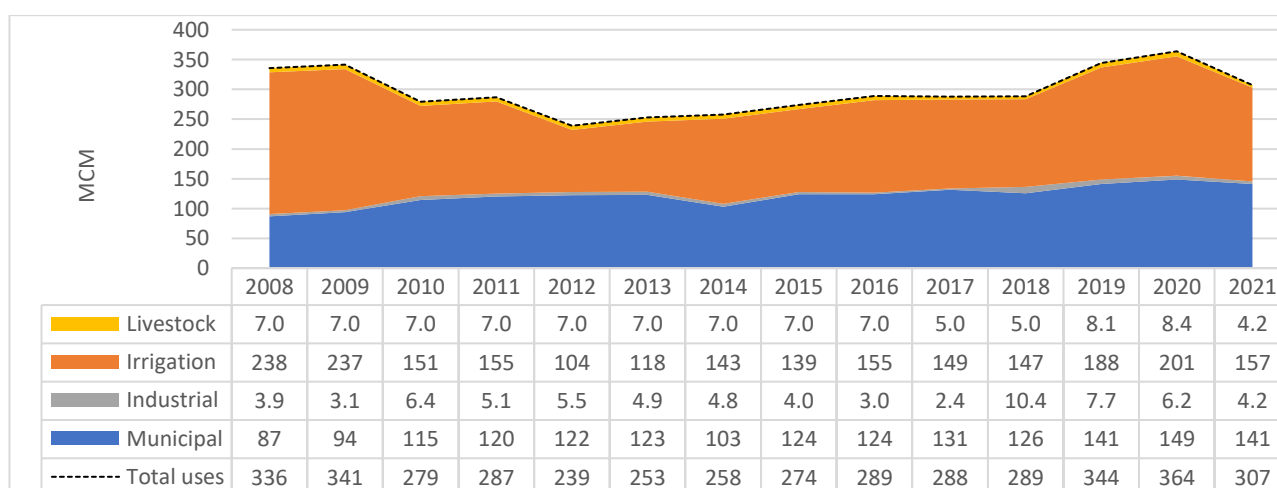
The surface water quantity is mainly dependent on the rainfall amount and its intensity and geographical distribution, as well as on land use and soil type. Thus, the available SW is largely fluctuating due to rainfall variations as shown in Figure 25 below. SW yearly discharge quantities could range from around 350 MCM to around 650 MCM.



**Figure 25: Historical Surface Water Availability and Rainfall Fluctuation (MWI Annual Water Budgets)**

Surface water storage is managed primarily through a series of dams, sediment builds up in these dams and is becoming increasingly problematic significantly, reducing surface water storage capacities. Accumulated sediments<sup>15</sup> in four out of 14 main dams represent an estimation of about 27% of the original storage (39 MCM out of 142 MCM total). Sediment accumulation also causes problems for dams' operations as many offtakes could be blocked and water cannot be released.

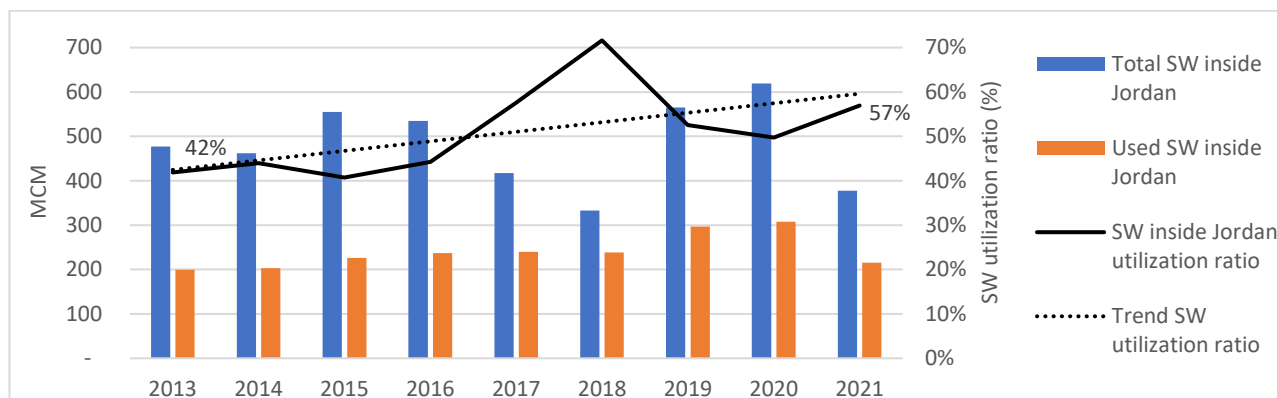
Figure 26 below shows how total surface water supplies are used across different sectors from 2008 to 2021. Two main features are noted in the figure. One relates to the municipal water annual quantity which continues to grow gradually to meet the increased demand. The second feature is the decrease of irrigation water quantities used in 2008 to 2013, during which period more reclaimed water was used. However, the irrigation water quantities started increasing gradually again and even peaked in 2019 and 2020 before returning to the 2016 level. Climate change, droughts, and expansion of reclaimed water reuse are also main factors affecting the use of surface water for irrigation.



**Figure 26: Surface Water Use over 2008-2021 [MCM] (MWI Annual Water Budget Reports)**

<sup>15</sup> GIZ & MWI, Third National Water Master Plan, Volume B, Annex B-3, 2022

Overall, surface water has been increasingly used over the last years due to the ability to harvest more water. Utilization ratio of all surface water has increased from around 42% in 2013 to nearly 57% in 2021, as illustrated in Figure 27. There is only a small room left for using more SW as technical issues have become more complex requiring costly investment rendering it less feasible. This is compounded by the trend of reduced rainfall and fluctuation in SW availability making utilization of SW more uncertain and less dependable.

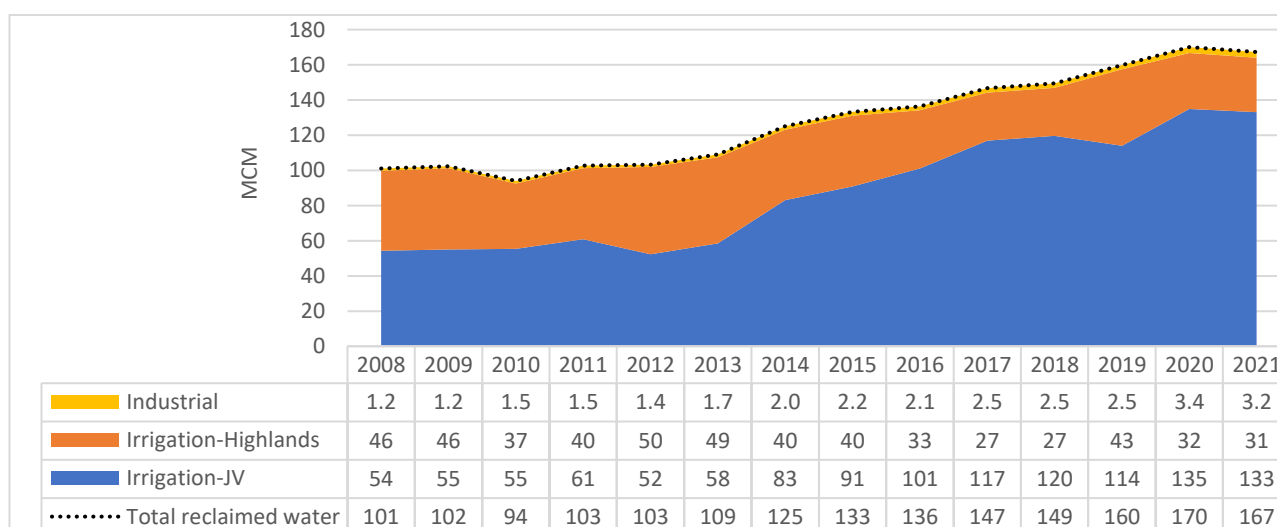


**Figure 27: Availability of Surface Water (SW) versus SW Utilization Inside Jordan**

Administratively, most of the surface water resources are managed by the JVA. There is an effective quantity and quality monitoring system in place utilizing SCADA systems at both King Abdullah Canal and the dams. However, these systems are not working properly in many dams due to weak communication signals and those dams are now monitored manually.

The Surface Water Utilization Policy 2023 has specified the utilization, protection, management, and optimum use of surface water along with specific measures that need to be followed toward a successful implementation of said policy.

**Treated wastewater, (also called reclaimed water)** is the third main water resource which is continuously increasing with more than 90% of Jordan's safely treated wastewater being reused particularly in irrigation. In 2021, around 186 MCM of wastewater were treated, and 167 MCM of which were reused for irrigation and industrial purposes contributing 15% to the national 2021 water budget compared with 11% 2011. Around 20% of the reclaimed water is directly reused and it varies from year to year. Figure 28 shows the steady increase in using reclaimed water over the past years. Administratively, the treated wastewater resources management is the responsibility of WAJ, while uses are shared between WAJ and JVA.



**Figure 28: Historical Reclaimed Water Reuse over 2008-2021 (MWI Annual Water Budgets)**

**Desalination** is mainly used for treating small quantities of brackish ground and surface water resources with a production level reach to around 53 MCM in 2021 and for seawater desalination, which is still a limited resource is in Jordan with minor contribution to the overall resources with produced quantities of less than 1 MCM. Small-scale desalination plants were initially installed for treating brackish GW and then expanded to SW. Starting in 2017, a sea water desalination plant was installed in Aqaba in partnership with the industrial sector with an annual capacity of around 5 MCM. However, the desalination plant faced technical operational problems which prevented it from producing the expected quantities. Desalinating brackish GW also faced a large decline mainly because of the limited availability of brackish GW and technical difficulties with drilling and maintaining wells. There are 31 desalination plants out of which 21 are currently operating (1 seawater and 20 brackish water). Desalination of sea water will be a priority in the related plans for future water resources, due to the unsustainability of groundwater, which represented an easy alternative for fresh water supply especially with the decline in resources of this water which does no longer meet the required demand.

**Shared water resources** are those water supplies that come from or stretch beyond Jordan's borders. This creates several additional resources management challenges on this water. Many of Jordan's water sources are located within neighboring countries. For example, groundwater basins in the North (Yarmouk, Badia, Ruqban), the Wadi Araba in the West, and in the Southeast (Sirhan) and in the South (Disi), as well as Jordan River and its tributary; the Yarmouk River; which are also shared with the neighboring countries.

There are three international and bilateral agreements covering some of these resources with the neighboring countries, while others are governed by precedent and practice. The water sector institutionalized Joint Water Committees with members comprised of its counterparts from the neighboring countries to cooperate and coordinate on issues related to shared water resources.

## Water Quality

Quality is a critical element of water resources management as it ensures that water treatment meets Jordan's quality standards to be safe for the intended uses. The quality of drinking water is subject to the JAS 286 Jordanian Drinking Water Standard and its amendments, applied to "water for drinking purposes" which is based on World Health Organization (WHO) Guidelines (Water Yearbook 2019-2020). Drinking water quality is monitored daily by several entities to assess compliance with these standards, where compliance is always above 99% for all different water system components. WAJ and the water utilities assess water samples using state-of-the-art laboratories accredited to ISO 17025:2017. In addition, the Ministry of Health (MoH) provides regulatory oversight on approvals, verification, monitoring and auditing according to Public Health Law No 47 for the year 2008 and JAS 286. The water quality monitoring data of WAJ and the water companies are regularly published and provided to MoH. The sector has implemented a laboratory information management system (water quality data bank) that is used to manage and share the water quality data among the laboratories of WAJ and the water companies.

WAJ and the water companies started on a voluntary basis to apply the water safety planning framework, developed by the WHO, as a risk management approach to water quality management, for several water supply systems to further strengthen quality control. Given the increased challenges on water quality that is impacted by climate change, WAJ and the water companies will implement the Climate Resilient Water Safety Plan (CRWSP) as a regulatory requirement as per the national preventative water quality management framework.

Treated wastewater quality is regularly tested against the Jordanian Standard for Reclaimed Domestic Wastewater No. 893/2021 to ensure it is safe for reuse in irrigation, but this capacity needs to be further developed as volumes of treated wastewater for reuse grow.



## Water Use Efficiency

Efficient water use is particularly important in Jordan due to the major economic and environmental effects given the severe water scarcity. Water use efficiency is often discussed in terms of productivity of water use or in terms of economic return (value) per cubic meter of water used (see Figure 29). Compared to other regional countries Jordan can greatly improve its water use efficiency in the irrigation and services sector. Jordan has many research and technology transfer institutes that work on testing and introducing new water efficiency technologies, especially in agriculture, that need to be further developed and deployed.

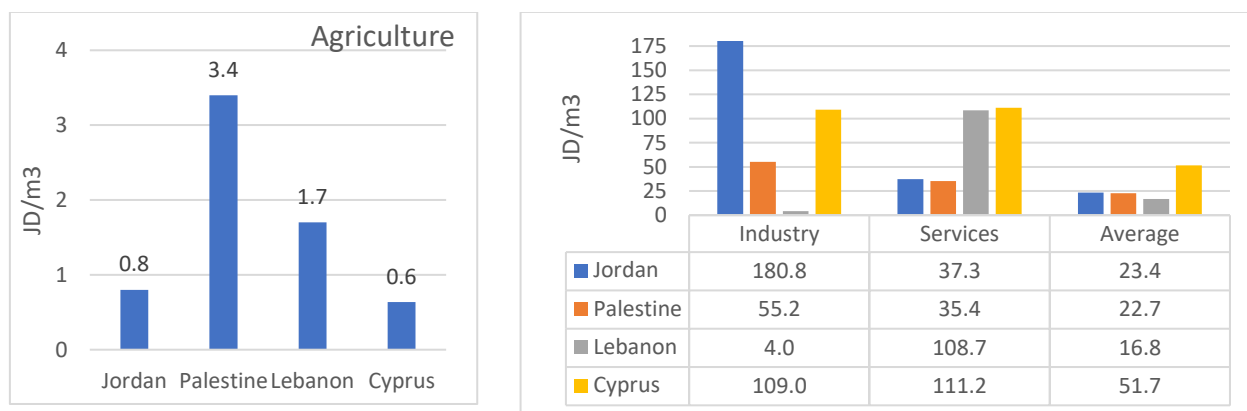


Figure 29: Economic Value of Water by Sector 2019<sup>16</sup>

## Key Challenges, Considerations, Opportunities, and Threats

**Water resources management.** Sustainable water resources management to achieve water security relies on a complex and highly interrelated series of factors. The key considerations range from policies, hydrological data on the characteristics of water resources and their utilization, sector capacity to meet the changing nature of challenges facing the sector, and the legal and institutional framework responsible for water resources. Key challenges include:

- The legal framework is comprehensive but needs to be updated to reflect the changing needs of the sector and the severe threat facing rapidly dwindling water resources.
- Enforcement of water management provisions is weak and both compliance and enforcement measures need to be significantly strengthened.
- Overlaps or conflicting roles and responsibilities across entities. The Public Sector Modernization Committee, formed by the honorable Cabinet in 2021, offers a unique opportunity to align needed institutional reforms within the water sector to broader national reform efforts.
- Several fundamentals of water resources management need to be strengthened, particularly as Jordan faces the reality that steadily and rapidly rising demand for water, in combination with climate change, are placing unsustainable strains on water resources that are already declining in productivity.
- Reliable data is a fundamental requirement to effective resources management and significant efforts are needed to ensure that accurate, timely, and reliable data is generated and used as the basis for decision-making and fed into existing tools like the National Water Information System (NWIS). For example, currently the volume of surface water runoff is not measured due to a lack of functional gauging stations, a reliable hydrological model that would produce correct results for runoff does not exist yet, and water quantities from some dams cannot be measured accurately.

<sup>16</sup> FAO (2019). AQUASTAT Core Database. Food and Agriculture Organization of the United Nations. Web: <http://www.fao.org/aquastat/en/>. Accessed Oct 2022.

- Planning and decision-making processes are not coordinated nor comprehensive and are too often in reaction to an emergency rather than long-term strategy and investment plans.
- Brain drains and departure of trained and experienced staff for opportunities outside of Jordan or in the private sector.
- Despite strong research institutes and academic expertise, linkages with the water sector management and operations are weak.
- The private sector can contribute to advanced management and infrastructure development, but capacity in developing and managing private sector partnerships is in need for enhancement.

**Water quality.** Jordan sustains global standards in drinking water quality and carries out thorough and regular testing on treated drinking water supplies with oversight from the Ministry of Health. This rigor is also needed in the management and protection of water supplies and treated wastewater for reuse. Groundwater resources are vulnerable to pollution and contamination from urban development and urban planning, discharge of brine from privately owned desalination facilities, and illegal dumping of waste in wastewater systems. This requires enforcement of water safety plans and water protection programs.

**Water use efficiency.** The industrial sector is a promising new sector in which to expand the use of treated wastewater and industrial water as a replacement for freshwater supplies. As the private sector prioritizes efficiency and cost savings in all operations, it can also be a catalyst for the application and advancement of more efficient water use technologies and practices. The challenge in realistically assessing the degree of savings and benefits resulting from efficiency enhancement, and water-saving technologies are mostly imported, and within Jordan, the scientific research for improving these technologies is limited. Equipment to monitor water use within the sector and across sectors is still incomplete or insufficient, and low water prices all limit the financial incentive to improve the efficiency of water use, especially treated water for industrial and agricultural purposes.

**Shared water resources management.** The regional political situations and conflicts affect the level of cooperation among the regional countries, their commitment to implement the terms and conditions of the bilateral agreements the exchange of information between them, and the ability to overcome difficulties related to the exploitation of shared water resources.

## Goal 1: Sustainably Manage Groundwater Resources to Restore Safe Yield Levels and Protect Groundwater Aquifers

Groundwater resources are witnessing a significant decline in water level and deterioration in terms of quality. Significant increases in water demand, paired with aquifer over abstraction beyond safe yields, has over-stressed Jordan's most important water resources and risks expanded permanent drying up of aquifers. Water security will only be possible with a rapid shift in how groundwater is managed to enable aquifer systems to recover and be sustained at safe yield levels and to provide protection from contamination.

### Objectives

Goal 1: Sustainably manage groundwater resources to restore safe yield levels and protect groundwater aquifers				
Indicator/Target: Annual abstraction reaches and sustains safe yield levels from 2035				
Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 1.1:</b> Reduce groundwater over-abstraction through the regular and reliable	Percentage of wells abstraction exceeding safe yield <sup>17</sup> abstraction	61%	~0%	2035

<sup>17</sup> Safe yield of a groundwater basin or aquifer system is defined as the amount of water that can be withdrawn from it without producing an undesired effect (Todd, 1959, Groundwater Hydrology).

analysis of safe yield levels linked to licensing and the water budget for all aquifers	Number of illegal wells	NA	~0	2035
	% of wells with licensed abstraction limits enforced	NA	90%	2030
<b>Objective 1.2:</b> Protect groundwater quality by minimizing pollution risks, as well as control on the release of untreated wastewater, and dumping of hazardous chemicals and materials	Raw water supplies are free from harmful contamination that exceed treatment capacity			ongoing

## Strategic Approach

**Strengthening enforcement of regulatory measures.** To limit groundwater over-abstraction, the sector needs to begin effectively and consistently enforcing the groundwater protection bylaw provisions. There should be specific emphasis on closing illegal wells in operation, enforcing maximum water abstraction limits from all licensed wells, and limiting agricultural expansion. Remote sensing should be expanded to allow for more continuous and impartial monitoring of well abstraction levels. Groundwater abstraction fees restructuring is also needed to better incentivize conservation and efficiency. It is also important to regularly review and update the groundwater policy based on the latest data around the safe yield of aquifers with abstraction limits established accordingly.

**Shift to groundwater conservation.** The country needs to fully pivot from overexploitation to groundwater conservation through several complementary measures. In addition to enforcement of abstraction regulations, the process needs to be accelerated to replace current substitute groundwater use with treated wastewater wherever it is possible and practical for irrigation, and introducing treated wastewater on a wide scale for industry will conserve groundwater supplies. Awareness and knowledge should be better developed on the current severe situation of groundwater resources, and the more efficient use of water, particularly in agriculture, such as use of irrigation technologies, shift in cropping patterns, and water saving devices, in addition to a systematic behavior change of all water users and key stakeholders.

**Strengthening implementation of municipal groundwater resources safety plans and water resources protection guidelines** through operationalization of existing protection zone regulations that restrict activities within defined zones for different water sources such as well fields and privately owned wells. This will guarantee a better protection of Jordan's aquifers as pollution of a single well can affect the quality of the broader aquifer system. Municipal groundwater resources protection legislation and regulations must be fully and regularly enforced. The water authorities should also focus on areas that are at high risk for illegal dumping of waste or untreated wastewater, through implementing decentralized wastewater management systems.

**Investigate new groundwater resources and enhance aquifers recharge** and exploitability of fossil groundwater where feasible. Adopt innovative desalination technologies for brackish groundwater, and increase its quantities. Investigate and utilize deep groundwater aquifers where it can be feasible and sustainable. Introduce artificial groundwater recharge projects in pilot areas to increase the safe yields of the aquifers.

## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
<b>WAJ/ Water utilities</b>	<ul style="list-style-type: none"> <li>- Launch a nationwide campaign on water resources and to eliminate illegal wells</li> <li>- Strengthen groundwater monitoring scheme and expand remote monitoring</li> </ul>
<b>MWI</b>	<ul style="list-style-type: none"> <li>- Implement Groundwater Sustainability Policy</li> <li>- Work closely with all relevant parties to enforce the groundwater related legislations</li> </ul>

	- Monitor achievements against targets to effectively manage and sustain groundwater resource through implementation of water resources protection guidelines
<b>MoA</b>	- Work with farmers to improve water use efficiency and enhance crops productivity
<b>MoEnv</b>	- Further enforcement of the environmental protection related regulations

### Human and Financial Resources and Requirements

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- Additional staff and capacity development in water quality testing, groundwater management, enforcement actions</li> <li>- Staff to maintain the telemetry system</li> </ul>	<ul style="list-style-type: none"> <li>- Capital investment in expanding and automating telemetric systems for remote well monitoring</li> <li>- Provide sufficient fund for maintaining the telemetry systems</li> </ul>	<ul style="list-style-type: none"> <li>- Effective and efficient partnership with stakeholders to minimize illegal exploitation of groundwater</li> <li>- Commitment to enforce groundwater management and protection measures</li> </ul>

## Goal 2: Sustainably Manage and Protect Surface Water Resources and Its Infrastructure

Surface water supplies make up about one-third of Jordan's total water supply and are also a vital source of water used for irrigated agriculture. Surface water systems, comprised of a series of dams, conveyance networks, and the King Abdulla Canal are strongly impacted by weather and climate by their very nature. Dams are losing storage capacity due to sediment accumulation over time. Sedimentation also creates operational problems in many of the existing dams with many offtakes that might be blocked so water cannot be released in a systematic manner. Surface water is vulnerable to illegal use and pollution given that they are open and accessible to anyone, but surface water systems are also a significant mixing network for treated wastewater used for irrigation and are critically important to achieving water security. To achieve this, more investment and stronger management is needed of surface water supplies and infrastructure.

### Objectives

Goal 2: Sustainably manage and protect surface water resources and its infrastructure				
Indicator/Target: Increase the volume of surface water stored				
Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 2.1:</b> Increase surface water available storage capacity through both improvements to existing facilities and new capacity	Available dams storage capacity (MCM) <sup>18</sup>	280	300	2030
	Water harvesting systems (ponds and desert dams) storage capacity (MCM)	122 <sup>19</sup>	TBD	2030
<b>Objective 2.2:</b> Increase the capture of treated wastewater to better manage allocation of these resources for a variety of purposes	Wastewater quantity diverted to allowable water surface bodies (MCM)	133	220	2030
<b>Objective 2.3:</b> Protect surface water resources against pollution from dumping of untreated wastewater, and release of hazardous materials	Full compliance with environmental management practices and regulations for all bulk water supply surface water facilities			From 2030

<sup>18</sup> The available dam storage is already partially modified based on the sedimentation level in the main dams and excluding Karamah Dam

<sup>19</sup> This is the design quantity and there is no estimation of the current available storage for those systems

## Strategic Approach

**Increase investment in maintenance and upgrade of surface water facilities.** An immediate priority is to increase the capacity of existing dams by treating sedimentation or increasing their heights if possible. New desert dams will need to be built to ensure that renewable surface water resources are developed to the highest extent practicable and advisable, while also being constructed to maximize groundwater recharge. Yet, these expansions in desert dams will be based on real hydrological studies, feasibilities and locations that serve groundwater recharge to the main well fields and water demands centers. The sector should encourage water harvesting systems at household, business, and farm levels to enable surface water collection that will contribute to reducing water supply demand. Expanding and constructing wastewater collection and treatment systems should take into consideration the need to protect surface water resources from flooding risks which can cause pollution as a result of untreated wastewater.

**Protect surface water infrastructure.** Stronger enforcement of legislative measures' implementation is needed and limitation of illegal use from surface water facilities. These are vital national resources and facilities that need to be fully protected in accordance with their value to the country and the economy. Public awareness campaigns can help educate about the harm to the overall water situation from vandalism and illegal water use to create public responsibility against these activities.

**Establish comprehensive monitoring and management programs for surface water quantity, quality, and protection.** Monitoring surface water runoff and developing reliable hydrological models are urgent requirements to analyze the surface water quantities and further related investment possibilities. Sediment accumulation in dams needs to be measured annually and sediment management and removal programs need to be designed. An integrated development and conservation program, that increases the number and degree of freshwater resources protection zones and assesses surface water development viability within the broader ecosystem context, is needed. This must be accompanied by legislation that allows for effective enforcement and penalties for violations of protection zones and development conditions. Water quality monitoring, analysis and data exchanging for treated effluent discharged into surface water facilities must improve and expand to ensure that standards are met. This will require additional funding, facilities, training, and coordination mechanisms with WWTPs and user groups. Particular attention must be given to adopting and enforcing sludge standards for municipal and industrial wastewater treatment plants with much more tightly regulated and enforced discharges from laboratories, hospitals, slaughterhouses, and similar businesses. The sector needs to more closely cooperate across government to strengthen urban planning and land use, ensuring surface water is considered and protected.

**Water reallocation plan.** The comprehensive annual and long-term water reallocation plan for all available water resources that are established will be improved, made more evidence-based and allowed for maximizing the socioeconomic benefits to water users and Jordan. The plan development is led by MWI in close coordination with all sector entities and in guidance of the Water Reallocation Policy and master plans.

## Institutional Roles, Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
JVA	<ul style="list-style-type: none"><li>- Conduct studies to explore the opportunities to develop and sustain surface water resources.</li><li>- Work closely with all relevant parties to enforce the surface water-related legislation</li><li>- Put adequate operation and maintenance plans to sustain capacities of dams and treat its sediments to restore capacities of these dams</li><li>- Mobilize resources to finance the development, maintenance, and operation of projects</li></ul>
MWI	<ul style="list-style-type: none"><li>- Review, update and implement Surface Water Utilization Policy and other related policies and plans.</li><li>- Develop and implement monitoring plans for measuring achievements and targets</li></ul>

## Human and Financial Resources and Requirements

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- Staffing plan to recruit qualified staff and to improve the knowledge transfer mechanism</li> <li>- Capacity development plan to enhance the staff capacity in terms of technical and administrative aspects of surface water management</li> </ul>	<ul style="list-style-type: none"> <li>- Capital investment for developing/investigating new resources</li> <li>- Maintenance and rehabilitation budget for the existing dams and systems</li> </ul>	<ul style="list-style-type: none"> <li>- Effective and efficient partnership and coordination with all stakeholders to protect surface water resources against pollution, vandalism, illegal usage, etc.</li> <li>- The relevant legislations and policies are fully enforced and applied</li> </ul>

## Goal 3: Take Leadership in Regional Cooperation for Shared Water Resources to Protect Jordan's Water Rights and Improve Water Security

Jordan is not blessed with abundant water resources and the groundwater and surface water resources it does have are largely shared with neighboring countries. This reality is further complicated by the fact that Jordan is "downstream" for many of these resources and so it is reliant, to a certain extent, on the compliance and cooperation of its neighbors for adherence to existing bilateral agreements and responsible resources management. Since Jordan is most adversely affected if the signed bilateral agreements for water rights are not executed, it is imperative that the water sector takes a leadership role in convening and strengthening the Joint Water Committees established to manage these shared resources. Regular efforts need to be carried out to enhance regional cooperation and coordination as competition and demand for these resources is only becoming more intense among the regional countries.

### Objectives

Goal 3: Take leadership in regional cooperation for shared water resources to protect Jordan's water rights and improve water security		
Indicator/Target: River basins and aquifers are managed as a holistic resource, irrespective of national borders		
Objectives	Indicators/Targets	Timeline
<b>Objective 3.1:</b> Strengthen shared groundwater basin management	Maintain the agreed upon water supplies available to Jordan from shared aquifers with neighboring countries	ongoing
<b>Objective 3.2:</b> Maximize sustainable allocations and productive use of shared surface water in the Yarmouk and Jordan River basins	Maintain and ensure sufficiency of the agreed upon water supplies available to Jordan from surface water flows with neighboring countries	ongoing
<b>Objective 3.3:</b> Strengthen transboundary water mechanisms to improve cooperation and shared resources management	Continue to implement and develop joint projects with neighboring countries	ongoing
	Ensure the continuation of regional coordination and cooperation in relation to shared waters, search for additional resources that enhance the existing ones, and enter into new agreements as possible.	ongoing

### Strategic Approach

**Transboundary water management must be addressed both at the political and technical levels.** Cooperation platforms with neighboring countries to ensure effective coordination and compliance with international agreements must be steadily and regularly strengthened and nurtured. The Joint Committees are already established in principle with water ministry counterparts in other countries and provide the ideal platform for building better cooperation. As such they need to be activated and empowered urgently. At the



technical level, the sector needs to ensure that it has accurate and reliable data and evidence around the changing quality and quantity of shared resources as the basis for management discussions as well as any needed negotiations and revisions to bilateral and multilateral agreements. Cooperation can also be enhanced through careful development, investment, and management in projects that provide multilateral or bilateral benefits. The sector needs to actively promote and identify the economic, social, and political feasibility of the projects to mobilize resources and public support to finance them.

## Institutional Roles, Responsibilities, Resources, and Requirements

### Institutional Roles and Responsibilities

Institutions	Key Institutional Roles
<b>JVA</b>	<ul style="list-style-type: none"> <li>- Continue with organizing, activating, and convening the Joint Water Committee</li> <li>- Investigate technical issues with partners and enable information exchange platforms</li> <li>- Coordinate across relevant ministries such as MoEnv, MoA, public security, and MoFA</li> </ul>
<b>MWI</b>	<ul style="list-style-type: none"> <li>- Provide the legal umbrella for the shared water resources strategy</li> </ul>
<b>MoFA</b>	<ul style="list-style-type: none"> <li>- Provide political support for the executive entities</li> </ul>

### Human and Financial Resources and Requirements

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- Dedicated staff with experience related to international water law and negotiation capacity</li> <li>- JVA Regional Water Resources Unit is fully institutionalized and operational</li> </ul>	<ul style="list-style-type: none"> <li>- Donor funding support for joint projects</li> <li>- Public budget, local financing, and private sector participation investment in joint projects</li> </ul>	<ul style="list-style-type: none"> <li>- Water Management Information System is fully functional.</li> <li>- The water quantity and quality measurement and monitoring systems are improved</li> </ul>

## Goal 4: Increase the Efficiency of Water Use in Households, Tourism, Industry, and Other Key Business Sectors

Although water efficiency in the service and industry sectors is reasonably high, every drop counts, and more work is still needed to improve overall efficiency and expand the utilization of water-saving technology.

### Objectives

Goal 4: Increase water use efficiency in households, tourism, industry, and other key business sectors		
Indicator/Target: Increase in water use efficiency and adoption of water-saving measures		
Goals/Objectives	Indicators/Targets	Timeline
<b>Objective 4.1:</b> Work closely with related authorities to implement, regularly review, and update (as needed) legislation and regulations for water use efficiency and water harvesting and grey water systems	Cooperation mechanisms are strengthened and a process of regular review and update of standards and technical regulations for water efficient appliances, plumbing products, water harvesting, and grey water systems is implemented	Ongoing
<b>Objective 4.2:</b> Promote consumer efficiency measures and provide guidance for improved water use practices, water-saving appliances and technologies, and utilization of water harvesting and grey water systems	Increase in proportion of households and consumers adopting water efficient practices, appliances, technologies, water harvesting systems, and grey water systems	Ongoing
<b>Objective 4.3:</b> Collaborate with business partners and industry to adopt improved water use practices, water-saving technologies, and water harvesting and grey water systems	Increase in number of businesses with updated water-use practices or technologies, water harvesting, and grey water systems adopted, year-on-year	Ongoing

<b>Objective 4.4:</b> Increase the use of water-saving practices, reuse, harvesting and recycling in industries to reduce the amount of freshwater used	Increase in overall volume of water recycled in industry; volume of water harvested; number of facilities with improved water use efficiency	Ongoing
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## Strategic Approach

**Increase awareness and adoption of water-saving practices.** The water sector needs to be a strong advocate and information source for the range of the most viable, impactful, and appropriate water-saving practices and efficiency measures for households and each main type of business and industrial use. This can include awareness raising programs, demonstration platforms, technology transfer tutorials, and publicly available guides to efficiency. The sector also needs to take the lead in enabling rainwater harvesting in households, business, and industrial facilities.

**Incentive programs for industry.** The sector can also consider implementing incentive programs for industry to expand the use of treated wastewater as well as to promote on-site water treatment and recycling. Water use efficiency regulations need to be regularly updated and consistently enforced. This encompasses water use efficiency standards in building and plumbing codes, water use ratings for appliances and similar products, and clear guidance on rainwater harvesting.

**Improve and enforce plumbing and water appliances codes and standards.** The sector will work with the different parties who oversee revising the plumbing and water appliance codes and standards to be stricter for saving water as well as to enforce them in the market and in new property development.

## Institutional Roles, Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
<b>WAJ</b> <b>MWI</b>	<ul style="list-style-type: none"> <li>- Outreach and awareness raising for water use efficiency</li> <li>- Continuously review, update, and implement relevant policies</li> <li>- Enforce existing/new legislations related to water use efficiency</li> </ul>
<b>Water companies</b>	<ul style="list-style-type: none"> <li>- Partner with high water use customers on water efficiency approaches and outreach to publicize benefits and return on investment</li> </ul>
<b>MoITS</b>	<ul style="list-style-type: none"> <li>- Develop an incentive program to promote water recycling technologies in the industrial sector</li> <li>- Improve and enforce the water appliances codes and standards toward more efficient ones</li> </ul>
<b>Municipalities</b>	<ul style="list-style-type: none"> <li>- Enforce the plumbing codes and rainwater harvesting regulation in the new property</li> </ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
Capacity development in range of appropriate and viable efficiency measures and technologies	<ul style="list-style-type: none"> <li>- Investment in testing and knowledge transfer for innovative technologies</li> <li>- Budget for incentive schemes for adoption of efficiency measures including tax exemptions, new tariffs, rebates, etc.</li> </ul>	Clear financial benefits to businesses and industry to adopt efficiency measures

## Monitoring and Evaluation

MWI will continue leading the overall monitoring and evaluation of the water resources use and efficiency within each economic sector and direct the national planning and policies to ensure sustainable utilization

of the existing and new water resources as well as increase the water use efficiency. Currently, WAJ is responsible for monitoring groundwater resources, and JVA is responsible for monitoring the surface water in JV including the regional transboundary water. However, once the bulk management entity is established, the operational monitoring and evaluation of both groundwater and surface water resources will be consolidated. It is essential to automate data collection processes and treating it, providing timely and accurate data.

## Conclusion

Effective management and protection of Jordan's water resources is a complex and critical function of the water sector. The national strategy recognizes this, and its goals reflect the need for holistic and integrated strategies that address supplies, uses, and improvements on the part of all elements of society from water authorities to business leaders and households. It also reflects that the water sector alone cannot deliver this goal on its own as a much stronger and consistent enforcement of existing water management and protection provisions is the responsibility of many parts of the government as well as the water companies. Achieving these goals is essential to the country's economic growth and to people's prosperity and quality of life. A running theme throughout each goal and objective is the need to have better and more reliable data on Jordan's water resources to improve every aspect of management, planning, and oversight. Furthermore, the water use efficiency and water quality objectives are directly linked to achieving the SDG targets.

## 5 UTILITY MANAGEMENT AND SERVICES

Service provider organizations in the water sector (utilities) are responsible for the production, treatment, distribution, delivery of water to customers, and wastewater collection, treatment and reuse. This chapter addresses the specifics of O&M and management throughout this system from the bulk and retail supplies of water and the wastewater treatment and reuse, identifies the problems and ways to be addressed essentially around five components (a) bulk water supply, (ii) wastewater treatment, (iii) water and wastewater infrastructure, (iv) use of reclaimed water (v) and sludge management. The ultimate level of services is measured by customers satisfaction, as the process of management and service operations is a complicated one, calling for high professionalism and accountability with clear identification of roles and responsibilities; achieving goals pertaining to the provision of water and sanitation equally, to reduction of Non-Revenue Water (NRW) in all water systems, and to safely manage wastewater treatment within public health requirements, and to protect the environment while maximizing supplies available for reuse.

### Current Situation

#### Bulk Water Supply

The bulk water system is defined as the system responsible to produce, treat, and transfer municipal water to the three regional utilities (Jordan Water Company - Miyahuna for Amman and the middle governorates, Yarmouk Water Company (YWC) for the northern governorates, and Aqaba Water Company (AW) for the southern governorates).

Jordan's bulk water system consists of the following key systems:

<b>Disi Aquifer System</b>	Transfers water from Disi to Amman, Zarqa, and the northern governorates. Consists of wells in Disi aquifers and pumping stations; and terminal reservoirs in Dabouq and Abu Alanda
<b>Zai Treatment Plant System</b>	Transfers water from the King Abdullah Canal (KAC) in Balqa governorate and purifies it in Zai Treatment Plant then transfers it to Amman so it is mixed with Disi Water in Dabouq Reservoir. Consists of intake, pumping stations at Dair Alla, multiple branches that feed Balqa area, and a Water Treatment Plant (WTP) terminal reservoir in Dabouq, Amman
<b>Zara Maeen System</b>	Transfers water from Moujeb Dam after purification to Amman and is then mixed with Disi Water in Abu Alanda Reservoir. Consists of reverse osmosis (RO) treatment and pumping stations and delivers the water to Abu Alanda reservoir, and also feeds areas in the Jordan Valley
<b>Za'tary System</b>	Transfers water from Zarqa and Mafraq Governorates to Irbid, Jerash, and Ajlun Governorates (YWC)
<b>Wadi Al Arab System</b>	Transfers water from several sources, including Wadi Al-Arab well fields, Tabqat Fahl, and King Abdullah Canal after purification at Wadi Al-Arab station, and then transfers it to Irbid, Jerash, and Ajloun Governorates. Consists of two parts; the first: Wadi Al- Arab and Tabaqet Fahl well fields from which water is transferred through several pumping stations to Zabdah reservoir in Irbid, and the second: withdrawal of water from King Abdullah Canal to a water treatment plant in Wadi Al-Arab and several pumping stations on the pathway of the first part.

The existing bulk water supply system facilities are managed by WAJ, JVA, and water utilities through a variety of different arrangements. For example, Disi is a BOT overseen by WAJ; Zai and Zara Maeen are managed by Miyahuna; and Za'tary and Wadi Al Arab systems are managed by YWC. There are also water supply systems managed directly by the utility companies.

Table 9 shows the percentage contribution from each system in 2021 in relation to the total supply at a national level.

**Table 9: Resources Percentage of Contribution to the Total Supply, 2021**

Supply Source	Supply (MCM/Year)	Percentage to Total Supply
<b>(a) Bulk System Supply</b>		
Disi	100	19.2%
Zai	83.5	16.0%
Zara Maeen	28	5.4%
Wadi Al Arab	26.2	5.0%
Za'tary	25.2	4.8%
<b>Total Supply from Bulk System (a)</b>	<b>262.9</b>	<b>50.4%</b>
<b>(b) Supply from other local resources</b>	<b>259</b>	<b>49.6%</b>
<b>Total Supply</b>	<b>521.9</b>	<b>100%</b>

The current bulk water system allows for allocation between the different Governorates except for the southern ones, which will be supplied by local resources (its share will be increased through the National Conveyance Project). The bulk system facilities are connected to SCADA allowing for more flexibility and reliability of operations.

## Wastewater Treatment

There are 31 wastewater treatment plants (WWTPs) across the country managed by the sector entities, six of which are septage plants. The current capacity of the WWTPs is around 600,000 m<sup>3</sup>/d, which is expected to be expanded to 800,000 m<sup>3</sup>/d over the next five years after completing ongoing and committed projects. As Samra WWTP has the largest hydraulic capacity of 365,000 m<sup>3</sup>/d, followed by South Amman WWTP with a capacity of 52,000 m<sup>3</sup>/d.

As Samra WWTP which is in Zarqa serves both Amman and Zarqa. And in 2021, As Samra WWTP absorbed nearly 68% of the wastewater flowing across the country. Studies are currently ongoing to establish a new plant in addition to As Samra to increase treatment capacity for Amman and Zarqa. Expansion and rehabilitation of some WWTPs will be studied in some Governorates, including the construction of two new WWTPs in Deir Alla and Naour areas, and Ain Al Basha WWTP in Baqa'a area instead of Balqa WWTP.

Most of the WWTP are SCADA operated and utilize relatively new technologies (activated sludge, trickling filter, etc.). And after the completion of the ongoing and planned expansions and rehabilitation of these stations, it is expected that the quality of the treated water will be improved to be used in agriculture within the Jordanian standard specifications. For this purpose, a strict quality monitoring scheme is applied by WAJ and the utilities to ensure treated wastewater quality is compliant with the Jordanian Standard JS 893-Reclaimed Domestic Wastewater. Jordan Standards and Metrology Organization, MoH and MoEnv (through the Royal Scientific Society) also apply a quality monitoring program for effluent of wastewater treatment plants.

## Water and Wastewater Distribution Infrastructure

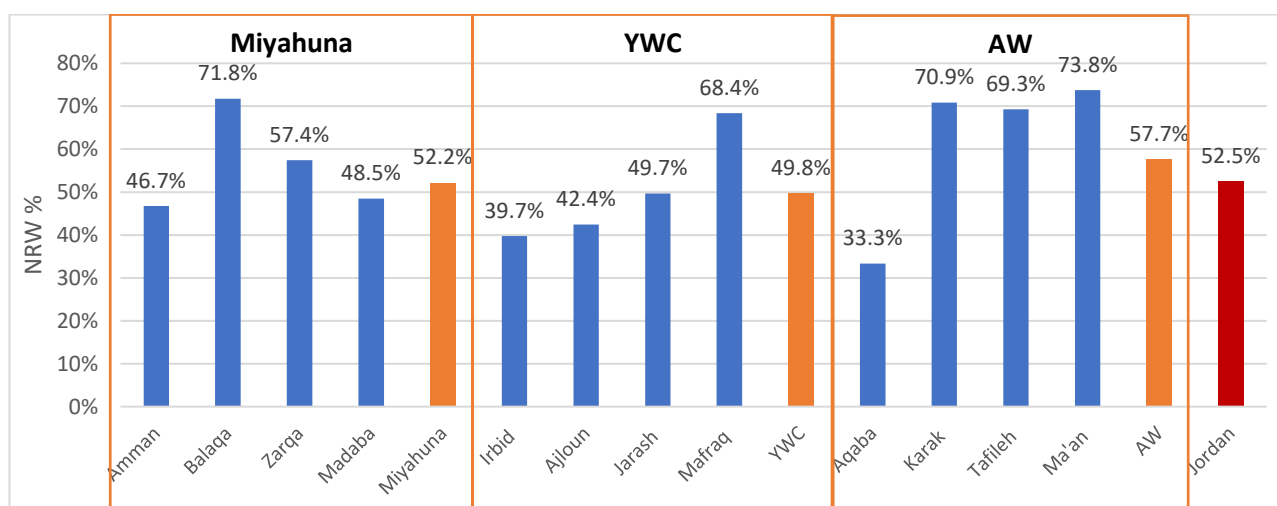
### Water Supply Distribution Infrastructure

The water supply infrastructure in each governorate consists of local wells, reservoirs, pumping stations, and the primary and distribution piping systems. The national coverage of the water system is high, reaching around 94% of the population. In 2021, total water quantities supplied through the national system was about 522 MCM.

Miyahuna manages the middle governorates water systems covering Amman, Zarqa, Balqa, and Madaba which constitutes more than 63% (330 MCM in 2021) of the consumption quantities in the Kingdom. Except for the capital, Amman, the infrastructure systems of the water networks within Miyahuna's service areas suffer aging and high-pressure variance, causing increased NRW quantities and low operational energy efficiency. In 2021, NRW ranged between 47% (Amman) up to about 72% (Balqa), with a weighted average NRW of 52% as illustrated in Figure 30.

YWC manages the northern governorates water systems for Irbid, Mafraq, Jerash, and Ajloun which generally consist of old distribution networks that are not pressure zoned. This makes managing NRW more difficult. House connections are also mostly old and cause high leakage levels in the tertiary system. In 2021, the northern governorates water system supplied around 21% of Jordan's total water supply at 112 MCM. NRW ranged between 40% (Irbid) to about 68% (Mafraq), with a weighted average NRW of 50%.

As for Aqaba Water Company (AW), in addition to Aqaba, it manages the southern governorates water system covering Karak, Tafilah, and Ma'an which is an old system and its transmission and distribution mains are worn-out with no pressure management, additionally most customers meters are inoperative. The water system in Aqaba governorate within Aqaba Special Economic Zone Authority (ASEZA) is very advanced and highly automated, including smart metering solutions. In 2021, the southern governorates water system supplied around 15% of Jordan's total water supply at 80 MCM. NRW ranged between 33% (Aqaba) up to about 74% (Ma'an), with a weighted average NRW of 58%.



**Figure 30: Non-Revenue Water Percentages per Governorate and Water Company in 2021**

To overcome the key challenges facing the water utilities in reducing the high level of NRW, the water sector developed in 2022 the National NRW Strategy for Jordan's Water Sector (2022-2040). This strategy becomes a part of the NWS.

### Wastewater Distribution Networks

The wastewater networks in the Kingdom's Governorates consist of wastewater collection networks, pumping stations, transmission mains, and treatment plants which transferred and treated around 190 MCM of wastewater in 2021. At a national level, Jordan has relatively high sewerage network coverage connecting 66% of population<sup>20</sup>. Sewer system coverage in the middle governorates has relatively good due to the highly urban nature of the service area and this will further increase upon completion of ongoing and committed projects in all areas of the Kingdom. The system currently collects and transfers 81% of the total wastewater produced in Jordan. There are some overloaded trunk lines in Amman and Zarqa which

<sup>20</sup> MWI / Wastewater Department Data including septage WWTPs



experience some overflow issues, especially in winter due to illegally connecting rainwater collection to the wastewater networks in building and some roads, instead of connecting and discharging it in a separate rainwater collection system. Several wastewater networks in the Kingdom, including Amman, Zarqa, and Balqa are old and need to be renewed and rehabilitated within priorities that are set for this purpose.

For the northern governorates sewer system, coverage ranges from 17% of population for Mafraq to about 50% for Irbid, served by five WWTPs<sup>21</sup>, forming in total about 12% of wastewater quantities produced in Jordan. Expanding the scope of coverage into new unserved areas through connection to the existing transfer sewer could be an issue considering the current limited system capacity.

In southern governorates, except for some immediate improvements required in both Ma'an and Tafilah, the existing sewage system has a good capacity, covering about 20% of the population in Tafilah and 85% in Aqaba. The quantities of produced water constitute about 6% of the total wastewater produced in Jordan. Since the system covers only the governorate centers in the south, the sector needs huge investments to expand its coverage to include the most widespread population centers, especially in Ma'an governorate. Projects to expand the coverage of the network will be carried out based on a study and analysis of the expected cost, return and environmental impact, especially on groundwater.

## Reuse

The quality of treated wastewater in Jordan is high enough to provide a range of reuse opportunities. Currently, reuse systems are mostly localized to the areas surrounding the WWTPs due to lack of transmission infrastructure for the recycled water to other areas. In 2021, the total amount of treated wastewater was about 186 MCM with around 130 MCM produced from As Samra WWTP and discharged into Wadi Zarqa and flowing into the King Talal Dam and then to King Abdullah Dam for reuse as irrigation water in the Jordan Valley.

The main reuse area currently is the southern part of the Jordan Valley, where freshwater is scarce. In the northern Jordan Valley, current major projects are ongoing to upgrade WWTPs and connect them to distribution systems which will also require some modification to the existing reuse distribution system. Though there are no major reuse activities in the highlands, MWI is considering expanding reclaimed water reuse in those areas. And excluding the Jordan Valley, Aqaba is among the highest users of treated wastewater due to the high quality of reclaimed water produced and the strong industrial demand for it, instead of the fresh water supplies which are needed for drinking water.

## Sludge Management

Sludge is a biological solid byproduct resulting from the wastewater treatment process at treatment plants. Most wastewater treatment plants in Jordan rely on sludge drying beds and either store the dried sludge at the WWTP facilities or transfer it to landfills<sup>22, 23</sup>. An inaccurate approximate quantity of about 100,000 ton of dried sludge was produced in 2020 from all WWTPs across Jordan, and it is forecasted to increase to around 135,000 ton by 2035<sup>24</sup>. Standard JS 1145 (2016) regulates the production, transportation, and reuse of biosolids. It classifies biosolids into three classes and restricts reuse options of each class. Type I and Type II sludge can be used as soil amendment in the rangelands, and Type III sludge can only be transported to sanitary landfills. The standard defines the reuse in rangelands as uncultivated non-irrigated rangelands, so crop cultivation is not allowed<sup>25</sup>.

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<sup>21</sup> Excluding Septage WWTPs

<sup>22</sup> USAID Water Reuse and Environmental Conservation Project Kingdom-Wide Biosolids Management Plan 2014

<sup>23</sup> Reuse of Treated Wastewater and Biosolids in Jordan | Nationwide Evaluation

<sup>24</sup> SSM Project Fact Sheet, GIZ 2021

<sup>25</sup> ICARDA, 2020 - [Focus Group Discussion Report Farmers' Attitudes Towards Biosolids use in Agriculture: Evidence from Jordanian Badia \(cgir.org\)](https://cgir.org/)

## Key Challenges, Considerations, Opportunities, and Threats

### Bulk Water Supply

- The current bulk water systems are operated by a combination of WAJ and the utilities, requiring well-coordinated planning and operations. These systems are using different SCADA versions that are not integrated, which requires WAJ to coordinate through the command center manually receiving operational data from each water utility and determining water shares accordingly, in coordination with the three utilities.
- Water quality management sometimes requires mixing supplies from different resources, where their quantities and qualities fluctuate due to seasonal and environmental variations.
- The current staff capacity is suitable to operate and maintain the level of complexity of the system.
- Funding required to expand or upgrade the bulk system is high as it involves lengthy pipes and high pumping capacities, as well as water treatment and storage facilities.
- Increasing energy costs due to advanced treatment and pumping over long distances (e.g., Disi to Amman) and high elevation difference between demand centers such as Amman and water sources.
- Various impacts of climate change on water system capacity to deliver stable water supply as output levels of the water sources are fluctuating.
- Illegal use and networks vandalism contribute to increasing system losses and cause regular supply interruptions.

### Wastewater Treatment

- WWTPs are mostly overloaded and expanding sewerage system is costly as it requires establishment of networks and treatment plants. Some WWTP locations face growing environmental and operational barriers due to urban development and growing encroaching on facilities, in addition to the challenge faced in reaching an agreement on the location of the new WWTPs in a way that satisfies majority of area inhabitants which can delay finalization of those projects.
- Low efficiency of some existing WWTPs as they operate above their capacity, which generates operational problems and disturbance to neighboring populations, and release of unpleasant odors, as well as not meeting the environmental requirements.
- Capacity limitations of onboard staff and insufficiency of required skills in O&M, which requires continuity in training and development to effectively operate and maintain newer and more complex WWTPs.
- The need to increase energy use efficiency and comply with standards that allow operational cost reduction, and taking advantage of renewable energy and/or energy production, such as biogas.
- Industrial wastewater treatment is limited and part of it is managed on-site within industrial cities. Remaining quantities are discharged into the sewer system that increases the biological and chemical loads on treatment plants.
- Sludge management practices in most WWTPs are weak. Better management will improve the environmental standards and create opportunities for reusing sludge for energy production and in other uses like soil conditioner and fertilizer if it does not contain toxic industrial chemicals.
- Both Illegal connections and stormwater runoff into wastewater networks in the rainy season overload or disrupt the treatment process, at times requiring untreated effluent discharge into Wadis, and must be avoided.
- Illegal industrial waste and Zibar disposal into the sewer systems is an environmental threat, deteriorating effluent quality and creating treatment challenges.
- Energy regulations limit renewable energy development and options from wastewater treatment operations, such as biogas, have not been widely developed so far.

## Water and Wastewater Infrastructure

- High NRW is the largest operational challenge for the sector and requires significant investments coupled with continuous water supply, rigorous management systems, and capacity to control and reduce.
- Weakness of existing systems due to unavailability of funds required for operations, maintenance, and investment, in addition to insufficiency of human resources qualified for these operations.
- Minimal levels of automation in the distribution system limit O&M and NRW improvements.
- NRW management is challenged by high variations in pressure in water networks as a result of the inconsistent development in supply networks at some Governorates.
- Overflow from wastewater networks in some areas creates environmental and health risks.
- Addressing the illegal connections to water and sewer networks requires improved coordination with security agencies to enforce the law.
- Some households and facilities do not benefit from sewer networks constructed in their areas as they cannot afford the cost of connection to those networks.
- Some wastewater systems face operational challenges related to reaching the end of their operational lifetime, the quality of materials used, and the limited capacity of those systems.
- Funds are prioritized for water projects, limiting expansion in wastewater services and the development of their systems.
- The management of the water institutions needs to consistently prioritize, and coordinate with other government authorities to increase funding for maintenance activities in the water utilities when preparing annual budgets.

## Reuse

- Normally, wastewater treatment plants are established near population localities, which could have some social and environmental impacts on that area. Locating WWTPs far from demand areas creates challenges related to the increased costs of the infrastructure needed to transport wastewater to these plants, and in some cases, the additional costs of transporting treated water to remote locations for reuse.
- Fluctuations in quality and quantity of treated wastewater throughout the year, because of the inefficient operation and maintenance of treatment plants and the difference in quantities between summer and winter, limit reuse opportunities; as reuse of treated wastewater in industrial and agricultural sectors require set quality standards and reliable quantities.
- Reduced demand for treated effluent during winter season, put limitations to discharge the reclaimed water, which creates a critical challenge.
- Groundwater is always a favored source unless legislation is adopted to promote use of reclaimed water and limit abstractions from current licensed wells.

## Sludge Management

Sludge management has not been sufficiently recognized in Jordan, as it is facing a number of challenges related to its existing basic treatment and utilization methodologies, along with its disposal to landfills that cause several key issues as following:

- Reduction in quality of surface and groundwater and soil contamination due to leachate.
- Missed opportunities for potential energy generation from sludge such as biosolids reuse in cement production or in incineration plants for energy recovery.
- High GHG emissions due to high methane formation during biodegradation<sup>26</sup>.
- High drying cost of sludge.

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<sup>26</sup> GIZ, 2014 - "Preliminary Assessment of Environmental Health & Safety Aspects of Current Sludge Handling Practices"

- High disposal costs associated with transportation from WWTPs to landfills (costs differ depending on the distance); estimated costs range between 7-28 JD/m<sup>3</sup> for dry sludge, and in the range of 2-4 JD/m<sup>3</sup> for liquid sludge (slurry)<sup>27</sup>.

## Opportunities and Threats

The following table summarizes the opportunities and threats in the management and operations of water utilities.

Opportunities	Threats
Major area for PPP, especially in the context of bulk water, WWTPs O&M, and NRW	a. Network expansions require major investment b. Energy cost's reflection on project costs c. Illegal connections and vandalism limit development and private sector's interest
Renewable energy generation; energy efficiency	Limiting regulations and absence of incentives for utilizing renewable energy and sludge as an energy source in the industry
Available donor funds, specially under the climate change funds	Uncertainty in prioritizing projects and weakness of feasibility studies that address climate change
a. Reclaimed water use for agriculture and industry can replace fresh water, allowing resources to recover b. The level of reclaimed water reuse vs. treated wastewater quantity is already substantial even though, it can be further increased c. Potential of benefiting from carbon credit through land application of sludge and its products (biochar)	a. Social and cultural reservations on reuse of treated wastewater b. Inability to update the current regulations needed to limit freshwater usage and expand reuse c. The presence of some restricted regulations on utilization of treated sludge as soil amendments

## Goal 1: Deliver Effective, Efficient, and Responsive Water and Wastewater Services to All

This goal reflects one of the top priorities for the sector in ensuring that water and wastewater services are as effective, efficient, and responsive to customers as possible. Achieving this goal requires addressing coverage levels, service levels, water quality, and reaching continuous supply for all.

### Objectives

Goal 1: Deliver effective, efficient, and responsive water and wastewater services to all				
Indicator/Target: National customer satisfaction levels sustained at international benchmark levels from 2035				
Goals/Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 1.1:</b> Expand utility water and wastewater services to achieve full coverage for cities and towns and access to safe water for villages	% of households connected to safely managed drinking water services through water network	94%	98%	2030
	% of households connected to sewerage sanitation services	66%	80%	2040
	% of people living in Jordan with access to safe wastewater services (sewerage and non-sewerage)	89%	100%	2040
<b>Objective 1.2:</b> Improve efficiency of network operations and maintenance to achieve continuous supply with minimal water losses	Install all needed network upgrades to prepare for and then adjust to the receipt of additional quantities from the national desalination and conveyance projects			2033
	Provide continuous supply of municipal water to all customers connected to the water network			2030

<sup>27</sup> UFZ, 2020 - Reuse of Treated Wastewater and Biosolids in Jordan | Nationwide Evaluation

	Execute 100% of legislative actions against illegal water connections and water network attacks to ensure fair water distribution to the rest of the customers	From 2028
	Execute 100% of legislative actions against illegal wastewater connections and wastewater network attacks to protect customers and the network from contamination and environmental harm	From 2028

## Strategic Approach

**Switch to continuous supply operations.** The water sector works on achieving and maintaining continuous water supply across the country from 2030. Water infrastructure master plans will continue to be updated against this criterion, addressing the full system of services from drinking water production, transmission, and distribution to customer connections. The developed master plans will be updated in 2024 and reviewed every three years or whenever needed. Investment priorities will be determined around improving network efficiency and expanding service coverage, and reflected in utility annual investment budgets. Achieving continuous supply in 2030 comes in time with gradually expanding service in new areas and improving networks efficiency, so they are able to support it and additional water comes from the National Conveyance Project. The plan will also address commitment to national, comprehensive, and continuous water supply rationing to achieve equality. The water sector will also continue its steady efforts in improving the infrastructure through 2030.

**Build O&M capacities of water utilities.** Management and operation of water and wastewater systems require qualified and trained human resources along with an incentive program that is aligned to the complexity and scale of operations and management. The water sector entities will work on increasing staff capacity development to improve operational efficiency and extend the life of infrastructure and assets. Each entity will develop a plan for continuous assessment of networks and facilities to determine rehabilitation or upgrade needs by 2024 and will update it annually. In addition, robust O&M asset management practices will be implemented for preventive and predictive maintenance activities by 2025.

**Regulate water companies and monitor their performance.** Performance management, accountability, and transparency are cornerstones of effective service delivery and customer confidence. For this purpose, the water entities will give attention to regulatory functions through enabling the Utility Performance Management Unit to expand performance monitoring to cover all governorates and bulk water supply by 2024. Utilities will develop their performance improvement plans, focusing on achievable targets based on their capacity, available resources, and financial performance. Sector water and wastewater services performance reports will be developed and published annually.

**Enforcement of laws and regulations.** Illegal use and over-pumping of private wells create immense harm for the sector and are essentially depleting the already very limited water supplies for different uses. Further, it costs the Government of Jordan and taxpayers tens of millions of JD in water that they have paid to produce, treat, and deliver to customers. Capacity development of human resources will target enabling them so they could identify methods for planning and implementation of campaigns to counter illegal connections. This will include both public outreach and methods to detect and correct illegal connections and wells. The sector will expand the use of advanced technologies like remote sensing to identify hot spots and undertake remedial actions. Workers will also be trained to strengthen their ability to collect appropriate evidence needed to successfully prosecute illegal water users. Additionally, the different governmental bodies will need to support the water sector entities in dealing with illegal cases and practices.

**Increase rates of connection on wastewater networks.** Innovative approaches will be introduced to encourage households to connect to sewer networks in the served areas. Additionally, reviews and updates

on existing regulations will continue in order to support water sector institutions and companies in increasing sewer network connections in the served areas.

## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
<b>Water companies</b>	<ul style="list-style-type: none"> <li>- Develop utility-level infrastructure plans in coordination with WAJ</li> <li>- Plan and implement switch to continuous supply on water system level</li> <li>- Strengthen and improve O&amp;M activities</li> <li>- Implement illegal use campaigns in coordination with WAJ and MoI</li> </ul>
<b>WAJ</b>	<ul style="list-style-type: none"> <li>- Develop national-level infrastructure plans to address water allocation and distribution</li> <li>- Carry out necessary and planned capital investments for water system restructuring</li> <li>- Implement illegal use campaigns in coordination with utilities and MoI</li> <li>- Increase penalties on illegal use</li> </ul>
<b>MWI</b>	<ul style="list-style-type: none"> <li>- Consolidate nationwide investment plan</li> <li>- Donor coordination and planning for capital investment</li> </ul>
<b>MoI</b>	<ul style="list-style-type: none"> <li>- Support implementation of illegal campaigns</li> <li>- Training of water sector staff and jurisdiction officers</li> </ul>
<b>MoH</b>	<ul style="list-style-type: none"> <li>- Monitor water quality</li> </ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- Water companies need to be staffed with qualified planning, operational, maintenance, customer services and technical employees</li> </ul>	<ul style="list-style-type: none"> <li>- Capital investment for water system restructuring</li> <li>- Sufficient O&amp;M budget</li> </ul>	<ul style="list-style-type: none"> <li>- Increase penalties on illegal use</li> <li>- Support enforcing illegal use regulations by Ministry of Interior</li> <li>- Introduce proper incentives to the staff</li> </ul>

## Goal 2: Reduce Non-Revenue Water (NRW) in All Municipal Water Systems to Increase Supply Quantity and to Ensure that New Water Supplies from Desalination are Utilized to the Greatest Extent Practicable

NRW reduction is essential for water security and one of the biggest sector challenges. This is a top priority for the sector particularly before starting the operation of the National Conveyance Project of high cost, which will lead to an increase in supply periods and a rise on water losses in the absence of effective control of the water supply systems. NRW reduction, both administrative and physical, will be addressed through improving operational efficiency, network upgrades, strengthening operations and maintenance, and developing human resources capabilities. The illegal use of water (whether it is illegal water connections or tampering with water meters), the inaccuracy of the meters and the errors related to the billing processes are among the most important causes of administrative loss, while the physical loss represents water leakage from pipelines, networks and other facilities.

Administrative loss will be addressed by replacing the old meters, automating them, improving billing processes, raising collection efficiency, and intensive work to reduce illegal uses. The water institutions will also put great efforts to reduce physical losses through a wide range of measures that will improve operation and maintenance, strengthen infrastructure and prudent management of operational pressures at pumping stations and in all water systems and distribution networks, and increase metering on main lines with the aim of measuring the quantities of water transported in those lines. In addition to working on reducing the response time for maintenance and handling complaints. The water institutions will expand automation and the use of smart systems and link them to the primary and secondary administrative and operational



processes to control water flows and pressure levels and integrated asset management with full linkage between the various functions of maintenance, operation, stores and customer service.

## Objectives

Goal 2: Reduce Non-Revenue Water (NRW) in all municipal water systems to increase supply quantities and to ensure that new water supplies from desalination are utilized to the greatest extent practicable		
Indicator/Target: NRW reduced from around 50% to 35% nationally when operating the national conveyance project, and to 25% nationally by 2040		
Goals/Objectives	Indicators/Target	Timeline
<b>Objective 2.1:</b> Reduce administrative losses across all municipal water systems to ensure that water that is treated and distributed reaches customers	<ul style="list-style-type: none"> <li>Ensure that 100% of municipal water customers are billed</li> <li>Reach 100% municipal water customers' billing generated from reliable meter readings by 2026</li> <li>Installation of accurate meters on water sources and transmission mains is 100% completed by 2026</li> <li>Continue work to reduce illegal water use and take legal actions against them</li> </ul>	Ongoing and continuous
<b>Objective 2.2:</b> Upgrade municipal water system management practices to reduce physical losses by controlling and rapidly repairing leakage and more effective maintenance and pressure management	<ul style="list-style-type: none"> <li>Restructure water networks to achieve 100% isolated District Metered Area (DMA) coverage with verified metering by 2030</li> <li>Water network regularly surveyed for invisible leaks when continuous supply is achieved</li> <li>Steadily reduce the number of pipe breaks per km of network while significantly improving the response time repair reported leaks and breakages, with appropriate timelines and targets set for each utility</li> <li>Improved operational pressure management and continuous monitoring</li> </ul>	Ongoing
<b>Objective 2.3:</b> Increase automation of water supply system operation	Control primary and bulk water transmission operations through SCADA by 2033	2033
<b>Objective 2.4:</b> Improve asset management	All utilities improve their asset management through an automated and integrated asset management system by 2030	2030

National NRW Strategy for Jordan's Water Sector (2022-2040) released in 2022 is considered part of this NWS, providing more details on the comprehensive strategic step towards managing NRW with key outcomes and investment needs to reduce to the targeted NRW. The implementation of this strategy has started immediately upon its endorsement.

## Strategic Approach

**Switch to continuous supply operation to better manage NRW.** To reach the NRW target, the water system must be under continuous supply, which enables leak detection and management of operational pressure in a continuous way, such that physical losses can be detected early and repaired quickly. This will take into account that the application of continuous supply will be in water systems and isolated distribution areas subject to monitoring and controlling.

**Develop, update, and implement utility-level NRW reduction plans.** The national NRW Reduction Strategy clearly articulates the priorities, strategic direction, and specific actions for NRW reduction in all water systems. Each of the water sector institutions shall have to correspondingly develop its utility-level NRW reduction plan that aligns with the water sector Infrastructure Water Master Plans. These plans shall identify priorities and investment needs to achieve NRW reduction targets.

**Build NRW management capacities of water utilities.** Build operational and management capacities of human resources and set appropriate programs for motivating them to plan and implement effective operations to address NRW and to conduct leak detection surveys. This will include development of plans

for installing the required meters and implementing operational pressure management. Asset management practices will be improved to carry out effective and ongoing maintenance.

**Implement PPP in NRW management.** PPPs can be a valuable tool in NRW reduction. Water institutions will define appropriate and feasible PPP cases and design the appropriate projects. capacities will also be built to develop and manage PPP contracts, building on previous cases, including the identification of areas for improvements.

**Ensure effective and continuous monitoring and measurement.** It is vital to put in place monitoring measures to assist in managing the NRW and setting priority actions, and in measuring, monitoring and analyzing flows and the operational pressure levels across the water system.

## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
<b>Water companies</b>	<ul style="list-style-type: none"> <li>- Develop utility NRW reduction plans</li> <li>- Implement automation and SCADA for primary and secondary systems with effective monitoring</li> <li>- Planning and gradual implementation of transition to continuous supply at the overall water system level</li> <li>- Implement proper O&amp;M activities</li> <li>- Implement illegal use campaigns in coordination with Mol</li> <li>- Implement performance-based plans</li> </ul>
<b>WAJ</b>	<ul style="list-style-type: none"> <li>- Implement illegal use campaigns in coordination with utilities and Mol</li> <li>- Increase penalties on illegal use</li> </ul>
<b>MWI</b>	<ul style="list-style-type: none"> <li>- Consolidate nationwide investment plan</li> <li>- Seek funds for capital investment</li> <li>- Institutionalize a PPP unit to develop future PPPs and support utilities in overseeing current PPPs</li> </ul>
<b>Mol</b>	<ul style="list-style-type: none"> <li>- Support implementation of inspections on illegal use of water</li> <li>- Train staff of water institutions and jurisdiction officers on legal procedures and requirements related to inspections on illegal water use</li> </ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- Water sector institutions staffed with qualified NRW management, planning, leak detection, operational, maintenance, customer services and technical employees</li> </ul>	<ul style="list-style-type: none"> <li>- PPP investment planning</li> <li>- Budget allocations for system restructuring and O&amp;M</li> <li>- Funding for meter installation and replacement</li> <li>- Budget for SCADA implementation</li> <li>- Performance-based incentive programs to be self-financing from the gains</li> </ul>	<ul style="list-style-type: none"> <li>- Agreement with related Governmental bodies on PPP cases and its feasibility, contractual terms, and financing.</li> <li>- Increase penalties on illegal use</li> <li>- Enforce illegal use regulations by related Governmental bodies</li> </ul>

## Goal 3: Safely Manage and Treat Wastewater to Protect the Environment, Health and Nature While Expanding Wastewater Services and Maximizing Reuse of Treated Wastewater

This goal reflects the importance of wastewater treatment for the environment and public health, and for securing additional water supplies through recycling and reusing in some fields of industry and irrigation. The water institutions will work on improving treated water quality and minimizing pollution of water resources with wastewater and hazardous chemicals. For this purpose, securing safe containment, transport, treatment of municipal and industrial wastewater, and efficient management of sludge (biosolids resulting

from wastewater treatment operations) to expand options for reuse and energy generation from biosolids. This will then enable further expansion in the use of reclaimed water in agricultural and industrial uses.

## Objectives

Goal 3: Safely manage and treat wastewater to protect the environment, health and nature while expanding wastewater services and maximizing reuse of treated wastewater				
Indicator/Target: Safe containment and treatment of all wastewater				
Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 3.1:</b> Ensure that all households, businesses, and government facilities within areas serviced with wastewater networks are connected	% connected to a sanitation system that is compliant with all relevant standards and regulations <sup>28</sup>	88.5% (2020)	100%	2030
	% of detected illegal waste discharge into wadis and public sewers that are corrected	NA	~100%	2026
<b>Objective 3.2:</b> Improve sludge management to reduce environmental impacts and seek opportunities for productive reuse (such as soil improvement, fertilizers, cement kilns or incineration with energy recovery)	% of sludge disposed in landfills from total sludge produced	NA	~0%	2030
	% biosolids reused	NA	TBD	2030
	% sludge used to generate Combined Heat Power (CHP)	~0%	TBD	2030
<b>Objective 3.3:</b> Expand reuse of reclaimed water	Volumes of reclaimed water used in irrigation and industry are increased to at least 95% of all reclaimed water			Ongoing

## Strategic Approach

**Implement sustainable sludge management.** The sector will build capacity and implement projects for sustainable sludge management from 2025. This will include integrating PPPs in WWTP operation and sludge management. The focus will be on improving sludge treatment to allow for reuse including options to adopt advanced technologies. Some potential opportunities can be: biosolids as fuel in cement kilns as an alternative energy source, use in incineration plants for energy recovery, biosolids converted to biochar (carbonaceous material) as a soil amendment and fertilizer, and introducing a sludge digestion system to produce biogas and generate energy in wastewater treatment plants. These efforts will need to be accompanied by updates to current regulations to expand internationally applied options for reuse and renewable energy generation. More advanced ideas could be upcycling solutions such as pyrolysis and pelleting which would allow the valorization of treated sludge as an alternative industrial fuel, industrial raw material, or as compost additive.

**Revise current legal and regulatory framework and improve compliance and enforcement.** Standards related to wastewater treatment need to be revised consistently with international best practices to expand sludge and reclaimed water reuse, respectively. Building relevant staff capacity across the sector and securing the required support for regulations' enforcement and implementing campaigns on illegal connected properties to sewerage system and discharge of wastewater is essential. Deploying appropriate technologies (e.g., tankers tracking systems) to identify and redress hot spots for illegal dumping and build capacity of water sector institutions' staff is vital to undertake their role as jurisdiction officers and build successful cases to take to court.

**Use communication and behavioral change campaigns to build public awareness and support.** The sector needs to engage in outreach and campaigns with agriculture sector stakeholders to explore the most viable options and build understanding of the benefits of biosolids reuse. Similar engagement with industries is

<sup>28</sup> This indicator is based on the SDG target 6.2.1

needed to develop agreements for reclaimed water sales to shift their water use away from groundwater resources.

**Expand coverage of wastewater networks.** The sector will develop an action plan that emerges from the National Wastewater Infrastructure Master Plan and define priority areas to expand sewer systems. New WWTPs are proposed for the areas with population centers over 5,000 people. The expansion of the sewer network will fully utilize the available WWTPs. Priority will be given to areas with high vulnerability of groundwater to prevent contamination.

**Develop and execute plans to expand the use of reclaimed water.** Expanding the wastewater collection and treatment system will generate additional reclaimed water, which will raise the need to develop and execute action plans to expand opportunities for reuse in different sectors, along with the conduction of an assessment to determine viable opportunities to expand reuse for agriculture and industrial sectors.

**Expand PSP in the management and operation of WWTPs.** Building on the existing fruitful experience in As Samra BOT, WAJ, and the water companies will expand deploying partnership with the private sector in management and developing existing and future WWTP through the different PSP forms.

**Build capacities of water utilities.** Build staff and capacities to plan and implement proper analysis to identify hot spots on sewer systems which could affect the treatment capacity. The target is to define spots of illegal wastewater discharge and update it annually.

## Institutional Roles, Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
<b>Water Companies</b>	<ul style="list-style-type: none"> <li>- Develop wastewater network expansion master plans</li> <li>- Search for PPPs opportunities in WWTP and sludge management</li> <li>- Identify wastewater reuse opportunities in agricultural and industrial sectors</li> <li>- Implement improved sludge management in WWTPs</li> <li>- Implement illegal use inspections on wastewater discharge and illegal use of wastewater networks in coordination with WAJ and MoI</li> <li>- Increase connection rates to the wastewater systems in serviced areas</li> </ul>
<b>WAJ</b>	<ul style="list-style-type: none"> <li>- Develop wastewater expansion master plans at national level</li> <li>- Implement PPPs in WWTPs and sludge management in coordination with water companies</li> <li>- Increase penalties on illegal use in coordination with concerned parties</li> </ul>
<b>MWI</b>	<ul style="list-style-type: none"> <li>- Revise legislations for reuse of reclaimed water and sludge reuse</li> <li>- Seek funds for capital investment</li> <li>- Implement communication and behavioral change campaigns</li> </ul>
<b>MoA</b>	<ul style="list-style-type: none"> <li>- Revising standards of sludge reuse in fertilizers and agriculture, in coordination with WAJ</li> </ul>
<b>JSMO</b>	<ul style="list-style-type: none"> <li>- Revising standards of wastewater treatment, sludge reuse and reclaimed water reuse in coordination with WAJ</li> </ul>
<b>MOITS, Chambers of Industry, MoEnv</b>	<ul style="list-style-type: none"> <li>- Advocating for wastewater reuse in industry, and the possibility of sludge reuse in energy intensive industries</li> </ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- WAJ and water companies need to be staffed with qualified, operational, maintenance, customer service and technical employees</li> <li>- Improve ability to attract and retain qualified staff</li> </ul>	<ul style="list-style-type: none"> <li>- Investment planning for O&amp;M contracts and PPPs</li> <li>- Sewer system expansion funding</li> <li>- Budgets to upgrade WWTPs and sludge management systems</li> <li>- Increase O&amp;M budget</li> </ul>	<ul style="list-style-type: none"> <li>- Updated standards for reuse</li> <li>- Understanding of safety and benefits for reuse of reclaimed water and sludge</li> <li>- Accountability for illegal wastewater discharge with Ministry of Interior support</li> </ul>

## Monitoring and Evaluation

The UPMU (or the future regulator) and Central NRW Unit should follow up with the water companies on their progress in achieving the goals of this strategic area.

## Conclusion

Achieving the three goals of the utilities' service management and operations is key to support Jordan's water sector to achieve water security through improving water use efficiency and protecting resources to achieve sustainability.

Key impacts include:

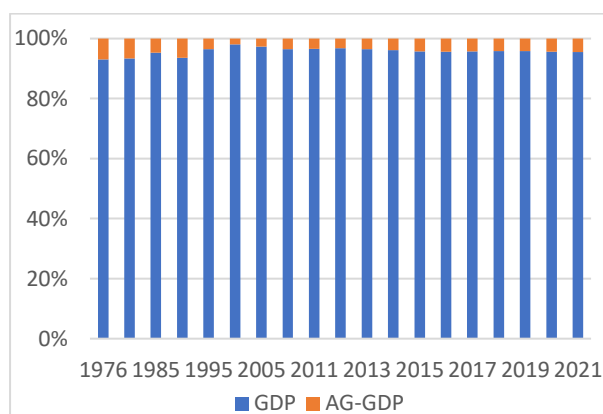
- Improving the level of service provided to all customers to support fostering social and economic development in the Kingdom.
- In addition to increasing operational efficiency and reducing costs; achieving reduced NRW helps improve water supply service through increasing water supplies and reducing service interruption.
- Protecting resources and preventing their contamination and getting more reclaimed water for reuse will help achieving water supply security.

## 6 IRRIGATED AGRICULTURE

### Current Situation

The agriculture sector has a unique significance for the National Water Strategy. Agriculture relies on water supply and all stakeholders involved must ensure that these supplies are sustainable, efficiently managed, and protected. The Ministry of Agriculture, farmers, and agri-businesses are responsible for agricultural production, policy, and sector management. Supplying irrigation water for agricultural production, however, is the responsibility of the water sector. Collaboration and alignment between the water and agriculture sectors is essential, combined with support from across the various Governmental entities, to create the balance between a vibrant agricultural sector and water security. This chapter addresses the national water sector strategy and priorities for managing, delivering, and protecting water supplies to ensure sustainable allocations to the agriculture sector for irrigation.

Despite its everlasting significance for the economy and society, the contribution of the agricultural sector to the national GDP has varied widely since the mid-1960s (See Figure 31). In the sixties, agriculture contributed up to 15% of the GDP and this contribution decreased to 3% during the period of 2000-2005. From 2015 and onward, the % contribution started to rise again and reached 5.2% in 2020<sup>29</sup>. Despite its modest contribution to the GDP, agriculture is an important sector in Jordan due to its role in water security and in providing the country with large volumes of the domestic food needs, especially fresh fruits and vegetables, and its role in employment and income creation particularly for the seasonal and the small size agricultural activities in the rural and Badia areas<sup>30</sup>.



**Figure 31: Agriculture % Contribution to GDP (1964-2020) (Central Bank of Jordan, 2022)**

Currently, Jordan is more than self-sufficient in many types of vegetables and most “indigenous” fruits. In addition, vegetables constitute the largest portion of agricultural exports. Most of the vegetables and fruits are produced using irrigation either from surface or groundwater. Figure 32 shows that field crops such as cereals and legumes are widely produced in Jordan, mainly under rainfed conditions. The data shows that the total cultivated area of field crops in the Kingdom in 2021 was 960,000 thousand dunums in 2021, of which 91% is cultivated under rainfed conditions and only 9% under irrigation, mainly producing barley, wheat, and clover.

Figure 32 also shows that the total area cultivated for vegetables is around 392 thousand dunums, with 92% produced under irrigation, mainly producing tomatoes, cucumbers, eggplants, squash, potatoes and other vegetables. The total cultivated area of fruit trees in 2021 was about 798 thousand dunums, of which around 55% are cultivated under irrigation and the rest are rainfed. The main rainfed fruit tree cultivated in Jordan is olives, which could also be irrigated.

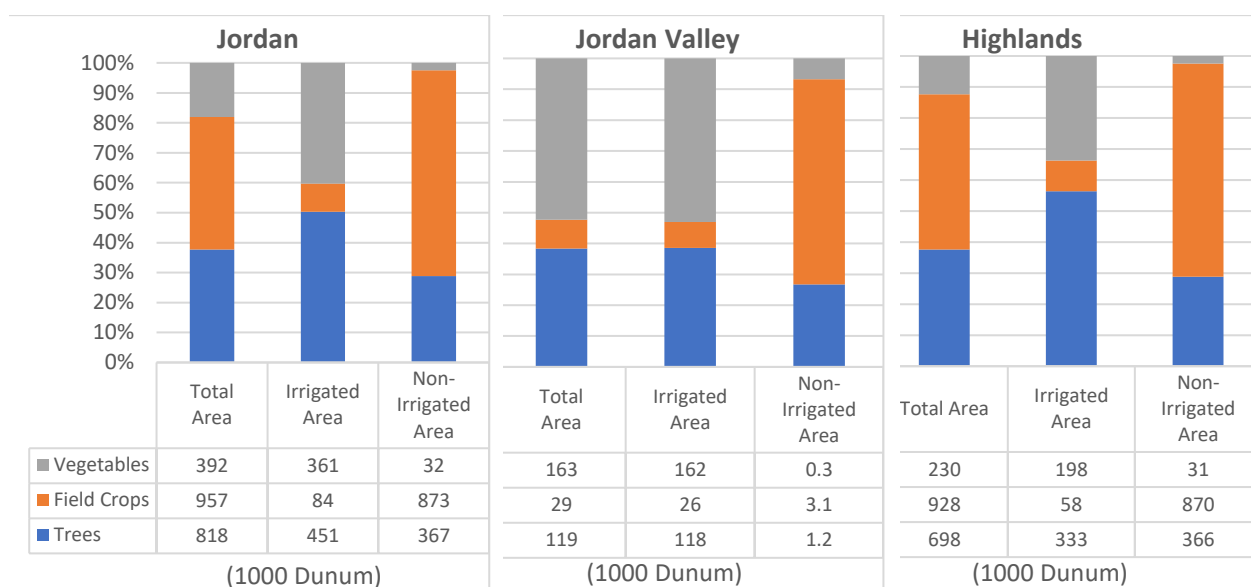
In the Jordan Valley (JV), the available lands for farming are considered steady and reach around 371,000 dunums, including 60,000 dunum in the South Shouna region, and 11,000 dunums in South Ghor that are not farmed due to the water unavailability. The water losses in all irrigation water systems in the Jordan Valley is significant and estimated in 2021 at around 27% of total water allocated for irrigation (about 108

<sup>29</sup> Central Bank of Jordan, 2022

<sup>30</sup> Ministry of Agriculture (2020) National Strategy for Agricultural Development for 2020-2025

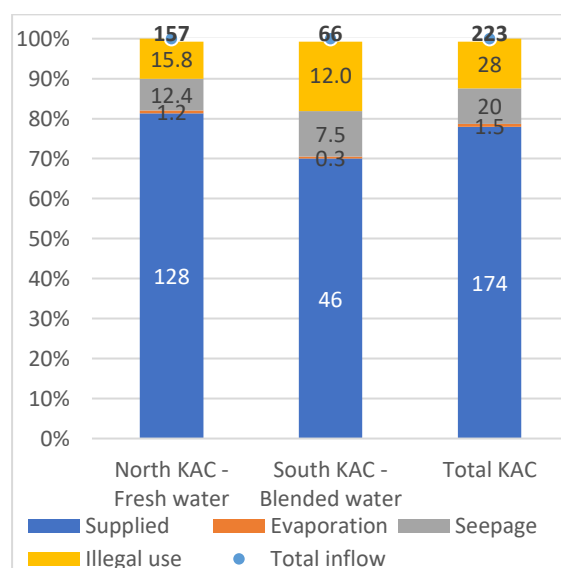


MCM). These losses represent the total water lost starting from resources and dams and through the conveyance system, in the King Abdullah Canal (KAC), and the irrigation distribution networks.



**Figure 32: Irrigated and Non-irrigated Areas by Crop Type – 2021 (Source: DOS, 2022)**

In KAC, the water losses in 2021 are estimated to be around 19% and 30% of the water flow in the northern and southern parts<sup>31</sup> respectively. The physical losses (seepage) in the KAC, which are estimated to be about 40% of total losses (around 20 MCM in 2021), is a major challenge that requires a large investment cost to reduce it, while in the irrigation distribution system, there is no reliable estimation for its value (USAID WMI, 2018<sup>32</sup>). The administrative losses from KAC and irrigation distribution systems represented by illegal offtake and use, reaches around 57% of total losses in KAC with a quantity estimation of about 28 MCM in 2021 as illustrated in Figure 33. Reducing this requires stronger regulations and enforced penalties for vandalism and illegal use. As for the remaining 3% of the water losses in the KAC, it is water evaporation from the Canal, which is less than 2 MCM annually.



**Figure 33: Water Losses Estimation in KAC for 2021 (figures in MCM)**

## Relevant National Initiatives

### National Food Security Strategy (2021-2030)<sup>33</sup>

According to the United Nations (UN) World Food Program (WFP), Jordan is classified as an upper middle-income country and as a food secure country with a score of 11.2 on the 2018 Global Hunger Index (Grebmer, et al., 2016)<sup>34</sup>. This indicates that the level of hunger in the country is moderate. Jordan's National Food

<sup>31</sup> The Northern part of the KAC is used to transfer the fresh water alongside the first 65 km of the KAC's length, while the Southern part is used to transfer the blended water alongside the remaining length of KAC (65-110 km).

<sup>32</sup> USAID WMI (Water Management Initiative) (2018) Determination of Water Losses in the KAC Conveyance System.

<sup>33</sup> GOJ, National Food Security Strategy (2021-2030) – in Arabic only, May 31, 2021

<sup>34</sup> The Global Hunger Index (GHI) is a tool that is calculated every year to measures and tracks hunger globally as well as by region and by country. A scale of 9.9 is considered low, while it is considered moderate if it is between 10-19.9

Security Strategy highlights that Jordan faces many challenges in attaining food security. These challenges range between structural and political factors including unemployment, high cost of living compared to income levels, high poverty rates, and sluggish economic growth. This strategy does not address, however, the fact that agriculture is the biggest consumer of Jordanian water resources. Food security needs to be managed in the context of the availability of water resources and should maximize the use of alternative water resources and prioritize ways to minimize freshwater consumption in agriculture.

In line with the Economic Modernization Vision, the National Food Security Strategy concluded that there is tremendous potential for improving the food value chain at all stages, from production through to trade, distribution, and consumption. This can be achieved through advanced technical solutions and good production practices such as hydroponics, effective irrigation systems, and shifting to high-value crops which will help to continue improvements in the productivity and competitiveness of Jordan's food industries, both domestically and internationally.

The National Food Security strategy does refer to water resources in a few locations. The Sectoral Priorities section (page 8) states, "Maximize the efficient use of available natural resources, particularly water, using modern irrigation systems, and the utilization of rainwater mainly through water harvesting". Also, under Complementary Strategic Intervention(s) (page 9), it states "Stop and or reverse the degradation and misuse of natural resources, i.e., land, water, flora and fauna".

### **Agriculture in Jordan's Economic Modernization Vision**

The "Jordan's economic modernization vision", launched in June 2022, revolves around the slogan "a better future" and is based on two strategic pillars: accelerated growth through the release of full economic potential, and the improvement of the quality of life for all citizens, with sustainability as a cornerstone of this future vision. The vision states that through the first pillar, Jordan can achieve qualitative leaps in economic growth and job creation over the next decade. Through the second pillar it can tangibly improve the quality of life so that Jordan can be at the forefront among other countries in the region. The economic growth for the vision is based on eight guiding principles: concentration, competitiveness, alignment, investments, exports, bonding, innovation, and inclusivity.

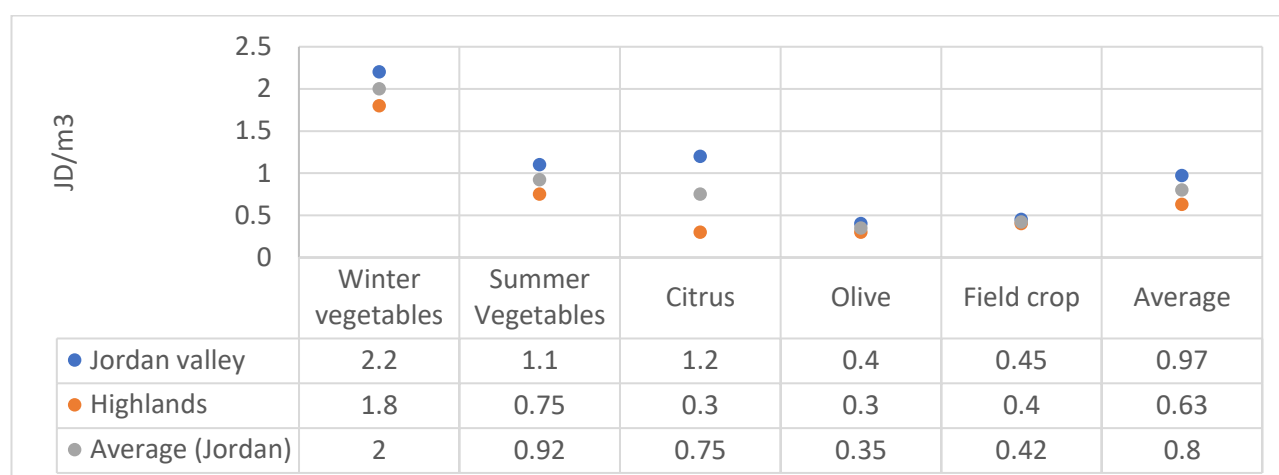
The vision included eight economic growth goals, among which are the water and agricultural sectors under the first and the fifth goals. Goal 1 is *"Develop Jordan to be a center for industry in the region by supplying high-value industries, fast-growing exports, with distinguished and high-value products"*. Goal 5 is *Improving the use and sustainability of Jordan's natural resources to launch sustainable resources-inclusive sectoral growth and improve the quality of life"*.

### **Economic Return of Irrigation Water**

The concept of the economic value of irrigation water has also become a key factor. The economic returns per cubic meter of water refers to the money generated in JDs per one cubic meter of water used for agricultural production. The same way is used to calculate water used in other sectors such as the industrial or tourism sector.

In 2021, the updated water economic valuation study concluded the following results concerning economic returns per cubic meter of water. The detailed results are shown in Figure 34:

- The economic return per cubic meter of water for the current local agricultural activities in the highlands is estimated at an average of JD 0.63/m<sup>3</sup> for all crops produced including vegetables and fruits.
- The economic return per cubic meter of irrigation water in the Jordan Valley is estimated at JD 0.97/m<sup>3</sup>.



**Figure 34: Return per Cubic Meter of Irrigation Water in Both Jordan Valley and the Highlands<sup>35</sup>**

## Key Challenges, Considerations, Opportunities, and Threats

As indicated in the National Agricultural Strategy of 2020, agriculture plays an important economic and social role, especially in rural areas, and contributes significantly to Jordanian exports. According to the International Trade Center (ITC) figures in 2020, the export of fresh vegetables and fruits amounted to JD 147 million and JD 101 million, respectively. Much of these fresh products are produced under irrigation in both the Jordan Valley using surface water and, in the Highlands using groundwater. The 2020 ITC statistics also show that total agricultural exports (including animal products) amounted to JD 818 million, representing 15% of Jordan's total exports.

Agriculture is considered one of the main sources of income for about 80,000 families in Jordan's rural areas. It provides approximately 10% of total employment for both Jordanians and non-Jordanians. Additionally, agriculture serves an important role in preserving biodiversity, vegetation, and soil properties. The sector can also help reduce the danger of desertification. Other major strengths of Jordan's agriculture sector include the ability to achieve self-sufficiency and food security in several products including vegetables and fruits, poultry, olive oil, and table eggs; but many agricultural products, such as wheat, barley, and red meat, are mostly imported.

A number of challenges related to the water sector face the agricultural sector and need to be addressed to achieve the goals of the National Agricultural Strategy of 2020. Overall, the economic return per one cubic meter of water in Jordan's agricultural productivity is low, and there are high post-harvest losses. There is limited use of the more efficient irrigation practices, in part because the irrigation water tariff has remained artificially low since decades, and farmers do not seek to rationalize water saving due to absence of incentives. Education has not kept pace with evolving market needs and has not enabled innovations needed in the agriculture sector. There is no comprehensive agricultural database with information on crop options, economic returns except for some new types of farming such as hydroponics, and other resources that could enable the irrigated agriculture sector to modernize and tackle water scarcity simultaneously.

Despite all these threats and faced limitations, there are still several opportunities for change and development of more effective and sustainable irrigated agriculture.

<sup>35</sup> Source: Water valuation for Key Farming Systems in Jordan: General Policy Considerations for Water Resources, USAID Water Innovation Technologies project

Opportunities	Threats
<ul style="list-style-type: none"> <li>Wide range of irrigation efficiency technologies available in the local market, along with many farmers and agri-businesses already using innovative solutions that could be more widely adopted</li> </ul>	<ul style="list-style-type: none"> <li>Lack of awareness within the sector. Outreach to farmers on the latest technologies, practices, and extension services do not target irrigation efficiency</li> </ul>
<ul style="list-style-type: none"> <li>Achieving progress in using non-conventional water sources for irrigation including treated wastewater and small-scale desalination of brackish water</li> </ul>	<ul style="list-style-type: none"> <li>Limitation of distribution networks for treated effluent, which limits the areas in which reuse is possible</li> <li>Quality levels need to be raised at some WWTPs</li> </ul>
<ul style="list-style-type: none"> <li>High demand for Jordanian agricultural exports</li> <li>Free trade agreements in place (World Trade Organization, ASEAN Free Trade Area, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>Limited freshwater resources</li> <li>Poor water quality resulting from blending treated water and freshwater</li> </ul>
<ul style="list-style-type: none"> <li>Government focus on economic growth and development opportunities – new production approaches and water-smart cultivation of high-value crops can be one solution</li> </ul>	<ul style="list-style-type: none"> <li>Traditional practices are low value crop patterns</li> <li>No formal incentives or policy shift to promote water-smart cultivation, high-value crops, or low-water production</li> </ul>
<ul style="list-style-type: none"> <li>Donor support for more effective and efficient agricultural production can be leveraged to pilot or accelerate new approaches or develop new markets</li> </ul>	<ul style="list-style-type: none"> <li>Enabling environment needs to be updated to promote and facilitate these approaches and market development efforts</li> </ul>

## Goal 1: Holistically Manage Water for Irrigation as a Vital Need for Jordan's Effective Integrated Water Resources Management, Economic Growth, and Innovation in Partnership across the Ministry of Water and Irrigation, Ministry of Agriculture, and Ministry of Environment

Agriculture is a vital sector for Jordanian society and economic growth, and its prosperity is dependent on water availability for irrigation. Current freshwater use for irrigation is among the major effects on water security. This is a shared problem between the water and irrigation sectors, which requires solutions that can be addressed through responsible management, innovation, and close cooperation, whereby the water sector works on NRW reduction, updating and expanding of irrigation water transmission and distribution networks to deliver supply more efficiently to agricultural users, while the agricultural sector supports the implementation of market mechanisms to create incentives for achieving water efficiency. The water and agricultural ministries need to continuously coordinate and facilitate needed reforms to agricultural policies and practices. Finally, the sector needs to focus on growing research capacity and technological knowledge within academia, research institutes, and the private sector.

### Objectives

Goal 1: Holistically manage water for irrigation as a vital need for Jordan's effective integrated water resources management, economic growth, and innovation in partnership across the Ministry of Water and Irrigation, Ministry of Agriculture, and Ministry of Environment		
Indicator/Target: Limit reliance of irrigation on freshwater by increasing use of reclaimed water for irrigated agriculture, more efficient irrigation systems and expanded rainfed agriculture and rainwater harvesting		
Goals/Objectives	Indicators/Target	Timeline
<b>Objective 1.1:</b> Implement mechanisms and regulations to encourage plant lower water-requirement crops and recognize water value as an economic input	Gradual implementation of mechanisms and regulations to incentivize planting lower water-requirement crops and disincentives planting high water-requirement crops	Ongoing
<b>Objective 1.2:</b> Continuously coordinate with the Ministry of Agriculture to manage irrigation water allocations, policy, and incentives	Coordination mechanisms in place with regular, ongoing consultations on key shared policy and planning issues including irrigation water allocation, irrigation water	Immediate

	pricing, crop-water requirements, and drought management	
<b>Objective 1.3:</b> Institutionalize communication channels with academia, research institutions, the private sector, and donor programs to drive innovation and technology adoption in water and agriculture sectors	Increased research projects, pilot technology pioneering projects, and regular exchanges between the water sector and academia, research institutions, private companies, and donor-funded programs	From 2023

## Strategic Approach

**Apply incentivizing market tools to increase productivity of irrigated agriculture.** In coordination with MoA, the water sector will work on applying different market and pricing regulations that contribute to motivating and changing agricultural practices for better utilization of water resources. These can include incentives to plant lower water-requirement crops and minimize planting high water-requirement crops.

**Establish sustainable institutional mechanisms to strengthen the relation with research institutions and private sector innovation.** The water sector will seek to develop and institutionalize formal relations in the water and agricultural sectors on one side, and with research institutes, academia, and the private sector on another side, to develop joint solutions to meet farmers' needs, achieve water and food security, and improve agricultural and water use productivity.

**Promote innovative approaches and technology adoption.** New technology transfer and adoption depends on farmers and investors initiatives, with no support and motivating mechanisms in place. Therefore, the sector will seek to be an advocate for new approaches and technologies. This should include supporting national research centers to apply and transfer water-saving technologies and irrigation techniques. Additionally, incentives can be introduced to accelerate using new water-saving technologies.

**Manage expansion of cultivated lands.** MWI, in cooperation with MoA, will work on organizing the increase of agricultural land areas ensuring its sustainability, and limit expansion that is not well organized and whose source of water is not sustainable. At the same time, responsible agriculture will be encouraged in the areas that utilize sustainable water sources, like replenishable or a non-conventional source.

## Institutional Roles, Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institution	Key Roles
MWI	<ul style="list-style-type: none"> <li>- Coordinate and lead effort on improving market regulations</li> <li>- Lead development and institutionalization of networks with research institutions, private sector, and donors</li> </ul>
JVA	<ul style="list-style-type: none"> <li>- In collaboration with MoA, apply agreed market incentive and disincentives to improve water use, increase its efficiency, and select better crops</li> </ul>
MoA	<ul style="list-style-type: none"> <li>- Collaborate to develop and support updated water allocations and freshwater management regulations</li> <li>- Extension services to target shifting to lower water-requirement crops</li> <li>- Manage the expansion of agricultural land areas in close coordination with MWI</li> </ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
Improved staffing capacity of MWI and JVA with economists, financial analysts, and researchers	<ul style="list-style-type: none"> <li>- Research funding and investment in financial management systems</li> </ul>	<ul style="list-style-type: none"> <li>- Update market regulations, and water allocations in coordination with different stakeholders</li> <li>- Establish water innovation center</li> </ul>

## Goal 2: Reduce Water Losses throughout the Irrigation Water Systems

Reducing water losses in the irrigation water systems is critical for a water scarce country like Jordan, and it is one of the key challenges facing JVA. Reduction of the water losses in the King Abdullah Canal and the irrigation distribution network will be done mainly through:

- Reducing the water losses in KAC from its current level estimated in 2021 at 19% (29 MCM/year) in the northern part and at 30% (20 MCM/ year) in the southern part to be around 10% (15 MCM/ year) and 5% (3 MCM/ year) respectively.
- Reducing water losses in the irrigation distribution systems by around 60% (From 37 to 15 MCM/ year).

### Objectives

Goal 2: Reduce water losses throughout the irrigation water systems				
Indicator/Target: Reduce water losses from leakage, illegal use, and billing and metering inefficiency to less than 25 MCM/year				
Goals/Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 2.1:</b> Identify and reduce water losses in King Abdullah Canal (KAC)	Volume of water losses in Northern KAC (MCM/year)	29	15	2030
	Volume of water losses in Southern KAC (MCM/year)	20	3	2030
<b>Objective 2.2:</b> Identify and reduce water losses in the irrigation water system in the Jordan Valley	Volume of water losses in irrigation water systems in the Jordan Valley (MCM/year)	37	15	2030

### Strategic Approach

**Build NRW management capacities of JVA.** Current operational and management capacities of JVA staff need to be strengthened to be able to plan and implement effective water losses reduction actions across the operational units of JVA. This starts with improving the irrigation systems' monitoring to identify high loss areas and determine the causes of such losses. Then, asset management improvements must become routine to carry out effective and ongoing maintenance to repair and prevent leakage and other losses.

**Stronger regulation and enforcement on illegal use.** Illegal use in the Jordan Valley is estimated to be the largest contributor to water losses. Regulations and associated compliance and enforcement actions need to be strengthened to minimize vandalism and illegal water use across the system, in addition to the significance of empowering JVA staff to improve their ability to monitor and control illegal use.

**Expand adoption and use of technologies in managing the water systems.** The Jordan Valley Authority will start prioritizing actions related to the management of water systems and introducing advance metering and measurement technologies that will provide accurate and reliable data and information to quickly identify water losses. Additionally, better automation systems will be enhanced, and irrigation networks control and operational pressure management systems will be installed and maintained to improve their efficiency which further reduces NRW.

**Improve and maintain irrigation water infrastructure.** The Jordan Valley Authority will work on updating O&M plans for irrigation systems in the Jordan Valley and steadily convert them into continuous supply systems, which allows for better management, more effective leak detection, and improved water supply services.

**Improve farmer cooperation irrigation systems management.** The JVA has a long history of productive and collaborative partnership with farmer groups from working closely with the Water Users Associations (WUAs) throughout the Jordan Valley. A thorough review and an updated partnership approach with farmers is needed to manage their irrigation distribution systems more effectively and fairly, which will also empower JVA in controlling illegal use from the KAC.



## Institutional Roles, Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
JVA	<ul style="list-style-type: none"> <li>- Reconsider and enforce existing regulations and illegal use penalties, and build staff capacity in effective water losses management, monitoring, and enforcement</li> <li>- Implement automation and SCADA for irrigation systems</li> <li>- Strengthen O&amp;M and NRW reduction program</li> <li>- Rehabilitate the existing main and tertiary networks</li> </ul>
WUA	- Work as a partner with JVA to reduce water losses and support controlling illegal use
MWI	- Facilitate donor support for irrigation water systems' water losses management
Mol	- Support illegal use enforcement campaigns and train JVA staff and jurisdiction officers

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
JVA staff qualified in water losses management, planning, leak detection, and O&M	Provide the needed financial resources for irrigation systems improvement, O&M, meter installation and replacement, and SCADA implementation	Increase penalties for illegal use with consistent enforcement

## Goal 3: Increase the Amount of Non-Conventional Water Used for Irrigation to Reduce the Burden on Freshwater Supplies Needed for Drinking Water

The water sector is fully committed to maintain the current water supply level for agriculture, with the need to reduce the volumes of freshwater used in irrigation and replace it with treated wastewater in order to protect aquifers in a way that maintains abstraction safe yield. The water sector will continue to expand wastewater treatment efficiency to increase both the quantities and quality of treated effluent that can be allocated for irrigation.

### Objectives

Goal 3: Increase the amount of non-conventional water used for irrigation to reduce the burden on freshwater supplies needed for drinking water				
Indicator/Target: Increase non-conventional water for irrigation to 45% relative to freshwater by 2030				
Goals/Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 3.1</b> Substitute non-conventional water resources, such as treated wastewater and brackish water, for fresh groundwater in irrigation	% of cultivated areas irrigated by non-conventional water in the Jordan Valley and Highlands	31%	45%	2030
<b>Objective 3.2:</b> Increase the use of non-conventional water resources in irrigation, particularly for any expansion in cultivated areas	Amount of non-conventional water used for irrigation (MCM/year) in the Jordan Valley and Highlands	164	279	2040

### Strategic Approach

**Improve treated wastewater quality.** The sector will steadily and continuously increase treated wastewater amounts and ensure that it meets quality standards for irrigation use.

**Substitute non-conventional water resources for groundwater.** The Ministry of Water and Irrigation, in coordination with the Ministry of Agriculture, will conduct research and coordinate with stakeholders to identify options for expanding the use of brackish water in irrigation, taking into account the negative

environmental impacts. This will include identifying vital, salinity-tolerant crops that can be irrigated with brackish groundwater, and identifying appropriate, cost-effective and efficient technologies and their use in some selected areas.

**Work on mitigating increasing soil salinity.** As soil salinity affects crops' productivity, MWI will work with its partners, particularly MoA and NARC, to develop and implement effective solutions to reduce the soil salinity, and to prevent soil salinization.

**Support expanded extension services and research around utilization of non-conventional water.** The water sector will coordinate with MoA and NARC to ensure up-to-date information is available around the utilization of non-conventional water sources.

## Institutional Roles, Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
MWI	- Support research around utilization and technologies to optimize non-conventional water sources and inform targeted extension services for non-conventional water usage
WAJ Water companies	- Increase treated wastewater quantity and improve its effluent quality - Develop needed infrastructure to transfer treated wastewater to farmers in the highlands
JVA	- Maintain and expand irrigation systems infrastructure to increase transfers of non-conventional water to farmers
MoA and NARC	- Target extension services toward use of non-conventional water
Research centers and academia	- Research and development for use and treatment of non-conventional water

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
Knowledgeable and trained staff in non-conventional water uses and treatment technologies in water sector and agriculture extension services	Provide the needed financial resources for expanded distribution of treated wastewater into irrigation water distribution systems	Effective and active coordination with MoA and NARC

## Goal 4: Increase the Economic Return for Water Used in Irrigation to Maximize the Benefit of Irrigation Water Allocations Given Jordan's Water Scarcity

While this goal is not wholly within the responsibility and authority of the water sector, it is vitally important to work on maximizing return of every drop of water used, and taking the economic value of water as a key determinant for agricultural policy, crop selection, and the type of water supply that is most appropriate for a specific crop. This requires focus on water use efficiency, switching to cultivation of high value crops, and annually reassessing the economic value of water for crops to enable evidence-based policy formulation, planning, and decisions.

## Objectives

Goal 4: Increase the economic return for water used in irrigation to maximize the benefit of irrigation water allocations given Jordan's water scarcity				
Indicator/Target: Economic return per cubic meter of water used for irrigation to steadily reach at least JD 1.1/m <sup>3</sup>				
Goals/Objectives	Indicators	Baseline (2020)	Target	Timeline
<b>Objective 1.1</b> Improved water use efficiency (at farm level)	% of water consumed efficiently per unit of product (ton) in reference to the standard water requirement of the crop <sup>36</sup> .	60%	75%	2032 (1.5% each year)
<b>Objective 1.2:</b> Increase cultivation of lower water-requirement and higher value crops	Irrigated area cultivated by lower water requirements crops (1000 m2)	TBD	TBD	2040
<b>Objective 1.3:</b> Regularly update the economic value of water used per crop annually to inform irrigation and agricultural policy and planning	Update and publish annual reports with reliable analysis of disaggregated economic value of water by crop type, irrigation water type, and region grown, which is widely disseminated to farmers and policymakers			Annually

## Strategic Approach

**Build knowledge and promote adoption of innovative technologies and on-farm practices in irrigation water management.** The proposed institutional collaboration between the water sector and universities and research centers (as further outlined in Chapter 8: Innovation, Technology, and Private Sector Engagement, Goal 2), includes targeted research on irrigation and water use efficiency, in collaboration with the private sector to test innovative technologies and accelerate technology transfer.

**Develop evidence in support of changing cropping patterns to less water consuming and high-value crops.** The water sector needs to carry out regular analysis of the economic value of water to provide the evidence base for the Ministry of Agriculture and farmers on how to maximize economic return and lower water consumption. This evidence can be used to facilitate behavior change related to crop selection, cropping pattern, irrigation practices, and water conservation, as well as to develop incentives that attract more water-saving crop production.

**Enable farmers' engagement in management of irrigation water.** Farmers' understanding and support are essential for achieving lasting and sustainable transformation of cultivation patterns and practices. The water sector can leverage existing WUA relationships to work in partnership to introduce new business models and engage WUAs as advocates for more sustainable agriculture and higher income generation.

## Institutional Roles, Responsibilities, Resources, and Requirements

### Institutional Roles and Responsibilities

Institutions	Key Institutional Roles
MWI	<ul style="list-style-type: none"> <li>- Provide the human resources needed at the Water Demand Unit to lead economic research on value of water</li> <li>- Institutionalize collaboration with academia and research institutes</li> </ul>
JVA	<ul style="list-style-type: none"> <li>- Leverage farmer relationships to advocate for new cropping patterns and efficiency measures</li> </ul>
MoA	<ul style="list-style-type: none"> <li>- Target extension services to move to high-value crops; determine and calibrate crop-water requirements; promote shifts to lower crop-water requirement cultivation</li> </ul>
NARC	<ul style="list-style-type: none"> <li>- Help in introducing innovative irrigation solutions and technology transfer and adoption</li> </ul>

<sup>36</sup> e.g., If tomato crop water requirement per one dunum is 600 cm per year while the actual (current) water applied is 1,000 cm, then the efficiency is  $600/1000 = 60\%$ . The objective is to reduce applied water per dunum to 800 cm (i.e., the efficiency will increase to  $600/800 = 0.75\%$ ) over the next 10 years.

Academic institutions	- Link science and advanced data analysis to the evidence-based decision-making process in the water and agriculture sectors
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### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
Economic analysis capacity within the water sector and extension staff in MoA	Funding for research and development	Collaboration mechanism with academia and research institutes

## Monitoring and Evaluation

Achieving the goals of irrigated agriculture requires collaborative monitoring among MWI, MoA, WAJ and JVA, in their respective responsible areas. Additionally, the Water-Energy-Food-Environment (WEFE) council should play a key role in ensuring that all parties are implementing their actions in harmony and in an integrated manner.

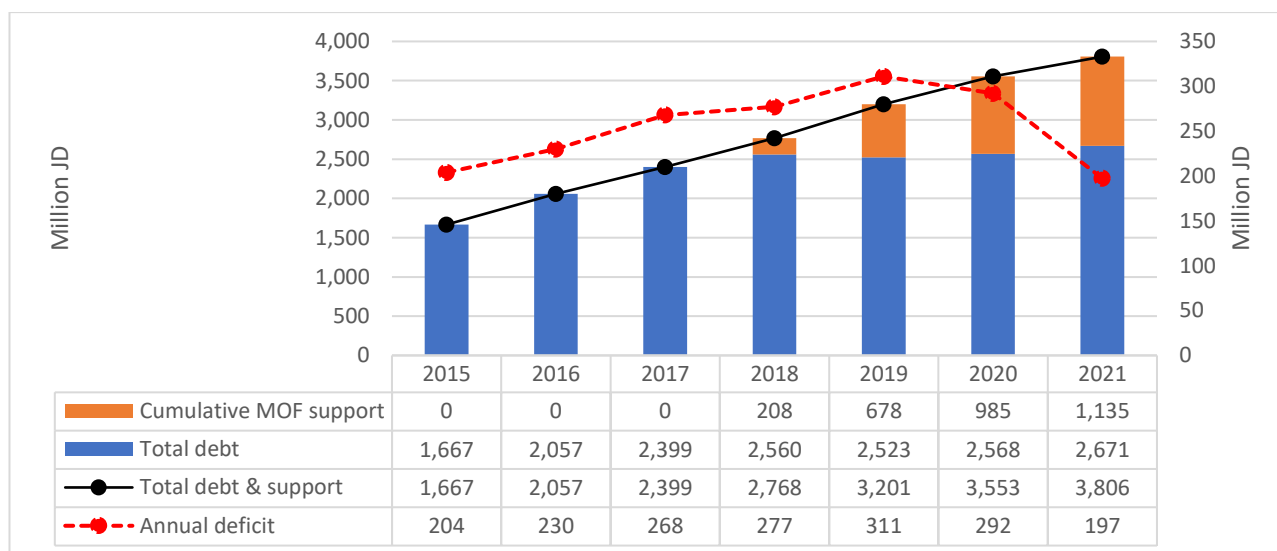
## Conclusion

Irrigated agriculture will continue to be one of the largest water users, which is why urgent irrigation reforms are needed in order to reduce the use of freshwater resources, increase irrigation water efficiency, and reduce the NRW in the infrastructure of irrigation systems, in addition to considering the importance of the joint stakeholders' collaboration at a national level, particularly in water and agriculture sectors, in order to achieve this goal and achieve both food security and water security in Jordan, and subsequently the national security.

## 7 FINANCIAL SUSTAINABILITY

### Current Situation

Jordan's water sector has been facing chronic financial deficits. Despite many attempts to suppress it, the consolidated financial deficit of the Water Authority of Jordan (WAJ) grew even larger over the years (to reach to 3,559 mJD in accumulated losses as reported in 2021 (WAJ consolidated income statement of 2021). In parallel, the reported total financial debt and support provided by the MoF also grew by more than double over seven years (from 1,667 mJD in 2015 to 3,806 mJD in 2021) resulted from the annual financial deficit ranged between 200 and 300 mJD over the last years as shown in Figure 35.



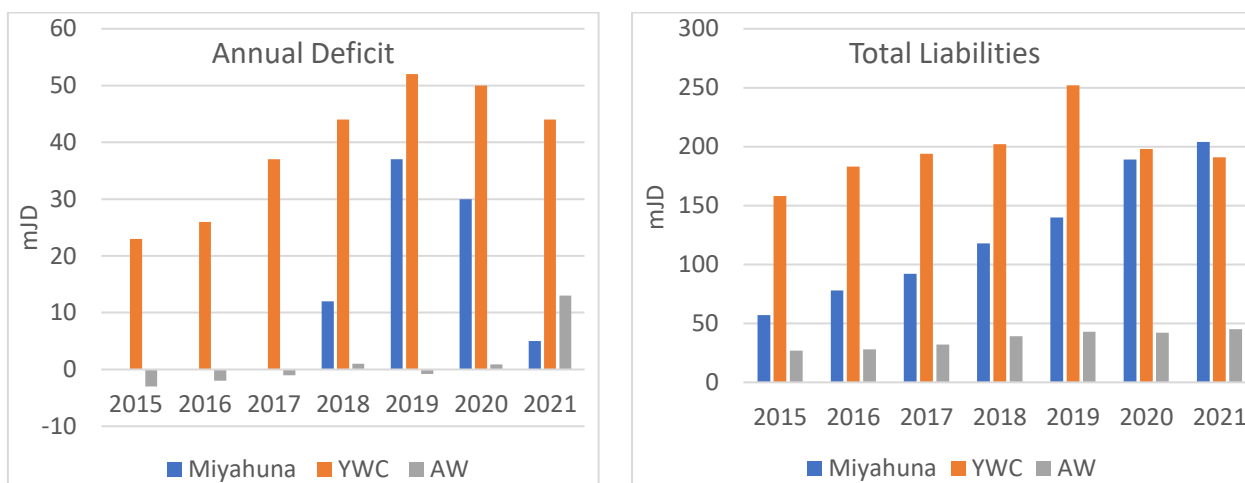
**Figure 35: Annual Financial Deficit, Debt, and Support Provided by MoF to WAJ (WAJ Consolidated Income Statements)**

Operating expenses also outstripped total direct and indirect revenues by 37 mJD in 2015<sup>37</sup>. Over the years, this operating deficit increased; in 2019 it reached 91 mJD and dropped to around 61 mJD in 2021 due to enforced mobility and movement restrictions during COVID crisis. As part of an electricity sector reform program, the government gradually started de-subsidizing the energy rate applied to the water sector in 2011, as the rate was increased in substantial yearly increments and with these, the water sector has become heavily burdened with electricity costs. In addition, the operation of Disi project in 2014 supplying water at substantially increased marginal costs was another factor that added more financial burden to this operating deficit.

WAJ stockpiled debt and liabilities even further, which in 2018 led the Ministry of Finance (MoF) to disallow WAJ to independently borrow additional funds from the local market. WAJ now relies on transfers from MoF to cover the deficit and manages delays of such transfers through a build-up of arrears to creditors.

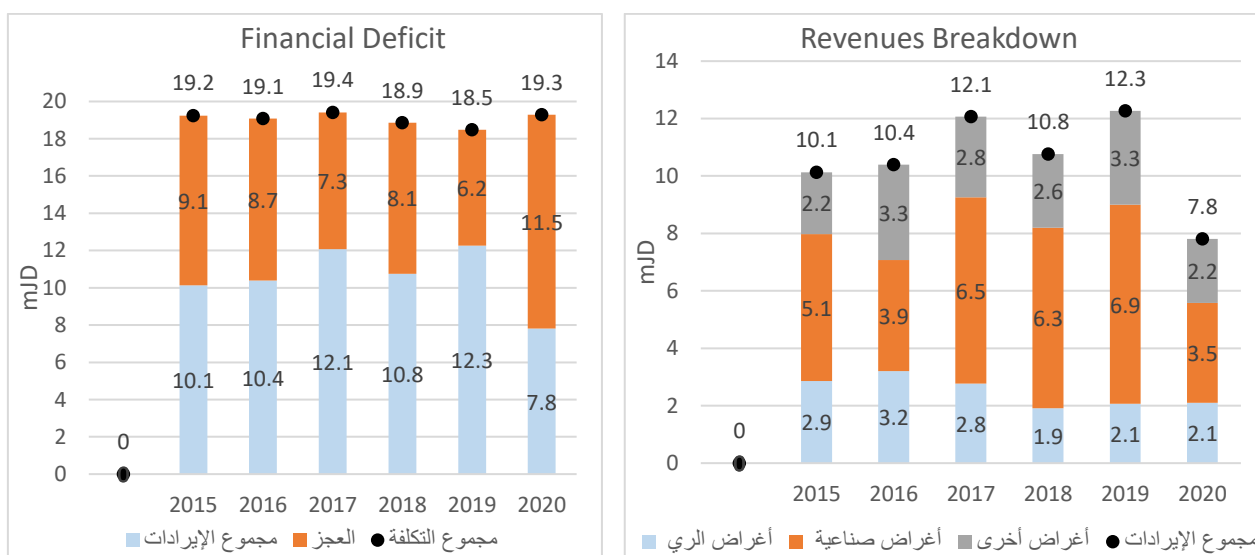
At the utility level and with varying degrees, the three water companies face an almost similar situation, where annual deficits and liabilities are growing from year to year as illustrated in Figure 36.

<sup>37</sup> Excluding amortization of deferred revenues



**Figure 36: Development of Annual Deficit and Total Liabilities for the Water Companies (Income Statements of Water Companies)**

The Jordan Valley Authority (JVA), which oversees managing surface and irrigation water in the Jordan Valley, is also facing a chronic operating deficit. JVA's financial situation shows an annual operating deficit of 9 mJD in 2015 that has progressively increased to around 12 mJD in 2021, as illustrated in Figure 37. This deficit is expected to grow if no actions are implemented to increase revenues. Moreover, JVA's key revenues from the water sales to the industrial sector dropped during the last years by more than half.



**Figure 37: Financial Situation of JVA over 2015-2021**

Cash collections in water sector entities have been in the 90th percentile but noticeably dropped into the 80th percentile in 2020 due to COVID-related restrictions. Against this drop, the receivables are building up and reached 335 mJD for WAJ and the water companies (water and wastewater services) in 2021. This receivable balance is more than 2021 total revenues.

The above clearly demonstrates that the sector's financial position is not on a sustainable path. The combined water sector operational cost including WAJ, water companies, and JVA amounted to 209 mJD in 2021. Therefore, and for the sector to continue providing and improving its services, it is necessary to expedite the necessary measures to address this deficit and increase revenues.

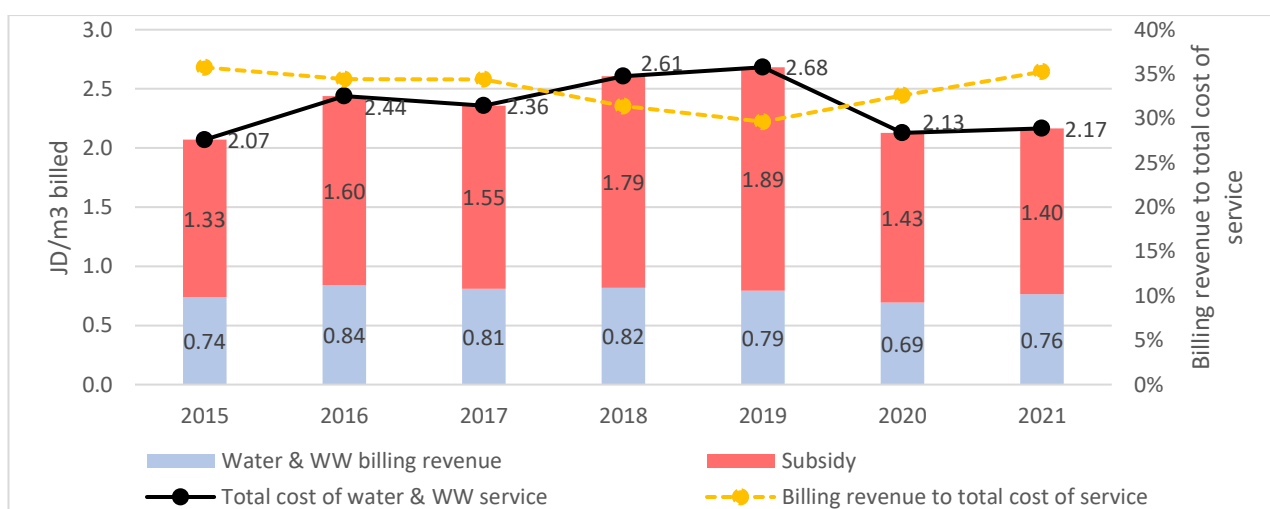


## Key Challenges, Considerations, Opportunities, and Threats

The water sector confronts complex and interrelated challenges, where one of the most important challenges is its heavy reliance on operational and capital subsidies because of the inability of low water and wastewater revenues to cover the cost of service and rarely even cover including the cost of operation and maintenance. This effects on the development and maintaining of water and wastewater systems, lagging of physical infrastructure behind the current and future needs, deterioration of service quality, and not sustainably maintaining water and wastewater assets reducing their operational lifespan.

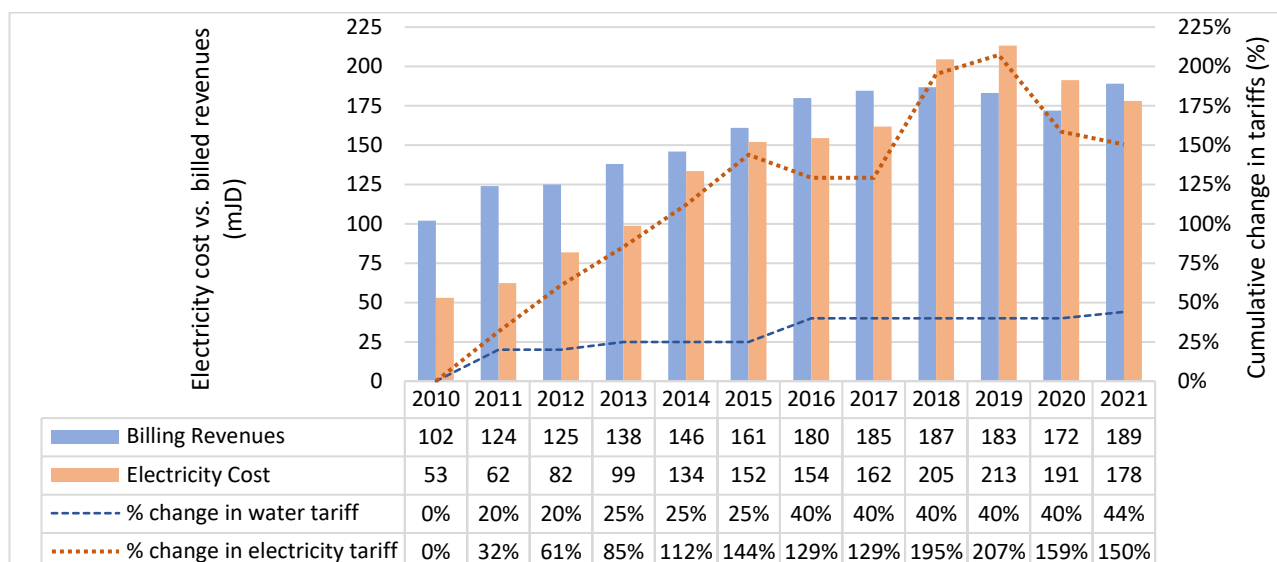
All the above are symptoms of unviable loss-making utilities that can still recover to a healthy situation provided the sector's challenges are properly addressed. Below is a deep dive into the sector's main financial considerations.

- Unit cost and revenue:** According to 2021 financial data and billed water quantities, O&M cost of one cubic meter of water and wastewater services (including O&M cost for BOT projects) is around 1.48 JD/m<sup>3</sup> billed against a revenue of 0.76 JD only, while total cost including capital cost of one cubic meter is around 2.17 JD/m<sup>3</sup> billed. This means that **each cubic meter of water and wastewater services received around 1.4 JD/m<sup>3</sup> billed** as illustrated in Figure 38.



**Figure 38: Historical Cost, Revenue and Subsidy of Water and Wastewater (WW) Services**

- Electricity cost (Estimated at around half of O&M costs):** The water sector is highly dependent on electricity use to provide its services for mainly spatial reasons of distant water sources and the variant topographic elevations between demand centers and production sources. The increased electricity rates over the last several years made the energy costs a heavy burden on the sector, and its deficit exposed to volatile monthly energy rates. It has even exceeded the total billing revenues (water and wastewater bills) over 2018-2020 because of the sharp and continuous increases of electricity tariff, as illustrated in Figure 39, while water tariff has almost not changed since 2016. As a mitigation measure, the Ministry of Water and Irrigation (MWI) embarked on projects to introduce renewable energy to operations, where just two large projects came online before putting restrictions on renewable farms of more than 1 MW.



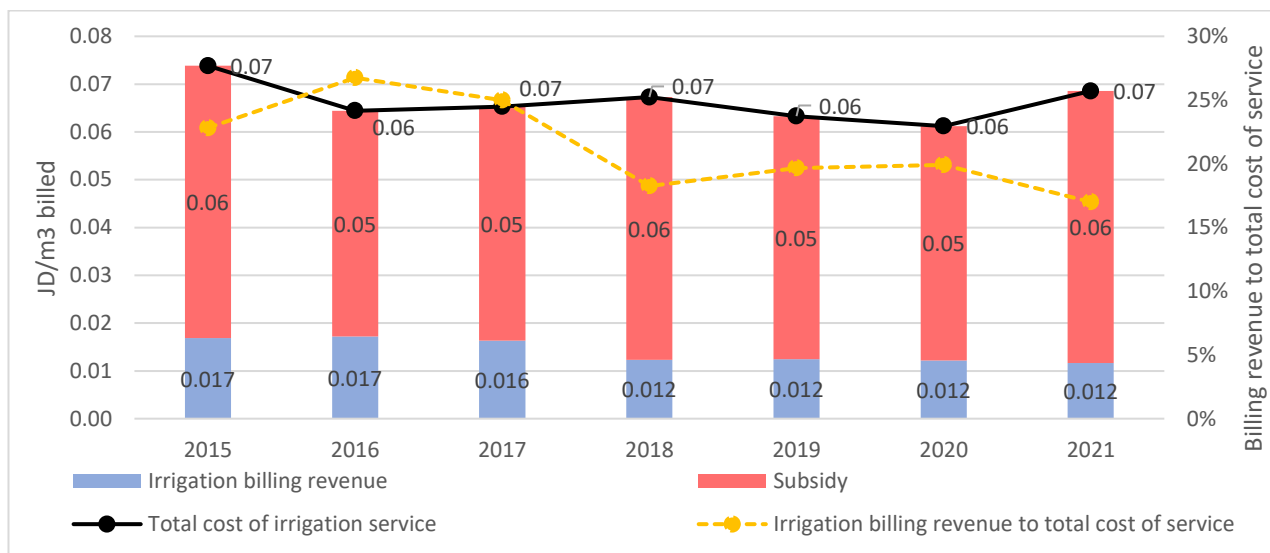
**Figure 39: Historical Change and Impact of Electricity Tariff on WAJ**

- **Maintenance:** The sector is under-maintained with most maintenance going to emergency repairs with no preventive or predictive maintenance being undertaken and there is not sufficient funds for maintenance in the annual financial budgets.
- **Non-Revenue Water (NRW):** The sector has been experiencing persistently high levels of NRW (around 50%) despite many attempts to reduce it, which causes the sector to lose about half of its revenues, despite the expenses that are already incurred. NRW is an important item that does not appear in financial statements but is a critical indicator that is closely associated with the performance and governance of the sector.
- **Tariffs to cover service costs:** Customer revenues from water and wastewater quarterly bills represent around 63% of total revenues, where 70% of these revenues comes from residential customers that has low subsidized tariff by GoJ and represent 95% of the total number of customers. While the non-residential customers that consume 16% of water have a flat rate that is not subsidized.

The structure of an increasing block tariff is supposed to incentivize conservation and subsidizes the lower consumers, but the current tariff structure does not cover except 75% of the operating cost of service, as 80% of the residential customers pay a tariff ranging from 0.4 – 0.6 JD/m<sup>3</sup> that covers only 30% of the O&M costs per cubic meter. This means that everyone is subsidized by the government equally, even those who can easily afford to pay.

The block tariff structure also provides variable revenues that depend on consumption, while the sector faces fixed costs given the need to continuously make the service available. For example, electricity cost is normally deemed variable in nature, but its same quantity is continuously consumed by the sector at full capacity because of the operational necessities that do not depend on billed water quantities. The mechanism of quarterly billing and collection reduces the financial costs but is not aligned with customers' monthly income when bills are due. This may have negative impacts on collections and public acceptability to pay their dues on time. As a result of this situation, the current water and wastewater billing revenue (the average tariff of both residential and non-residential customers) affects the cashflow and increases the government subsidy by around two-thirds of the total cost of services as illustrated in Figure 38.

In the irrigation sector, where the current irrigation tariff averaged at around 0.012 JD/m<sup>3</sup> is way below the total cost of service, which is around 0.07 JD/m<sup>3</sup> as illustrated in Figure 40.



**Figure 40: Cost and Revenue of Irrigation Service in Jordan Valley**

- **Other revenues items (sewerage tax (makes up 13% of total revenues), connections fees (6% of total revenues), etc.):** Details of each item vary in terms of frequency (one-time, annual, etc.), as well as the basis of calculation (mostly capital in nature). Sewerage tax is being collected by municipalities with an absent mechanism to check the validity of amounts or their collection efficiency. On the other hand, billings, and collections-related wastewater connection fees for “After issuance of work permits by municipalities<sup>38</sup>” are currently not well enforceable.

Although different in nature, JVA also faces similar challenges. Until recently, revenues covered more than 50% of O&M costs, while cost recovery has currently dropped to around 40%.

#### JVA financials can be summarized as follows:

- **Expenses<sup>39</sup>:** Staff salaries represent more than 50% of total O&M costs while electricity represents around 20%. The remaining items represent other costs like costs of water purchased from Lake Tiberias as well as costs of supplies and spare parts (both around 15%).
- **Revenues:** Revenues are retail in nature and are classified into industrial, agricultural, power, and others. The industrial customers consume low quantities with a tariff recovers the whole cost. The agricultural customers are the major consumers, where the irrigation tariff is subsidized that was set in 1994. Power revenue comes from the sale of hydropower generated at King Talal Dam. Finally, there are other revenues that come mainly from leasing JVA lands for investment purposes.
- **NRW:** This is currently around 26% in irrigation systems in JVA and there is a good potential to reduce it and have more water available for sale to different users.

The journey toward financial sustainability is a lasting one, and until operation and maintenance cost recovery is achieved in 2023, the sector needs to work on increasing energy use efficiency, reducing NRW, continuously review the tariff structure in collaboration of other direct stakeholders, and establish and develop capital projects needed for achieving that. MWI needs to actively propose and implement proper and developed mechanisms in project implementation, investments management, and PSP wherever possible.

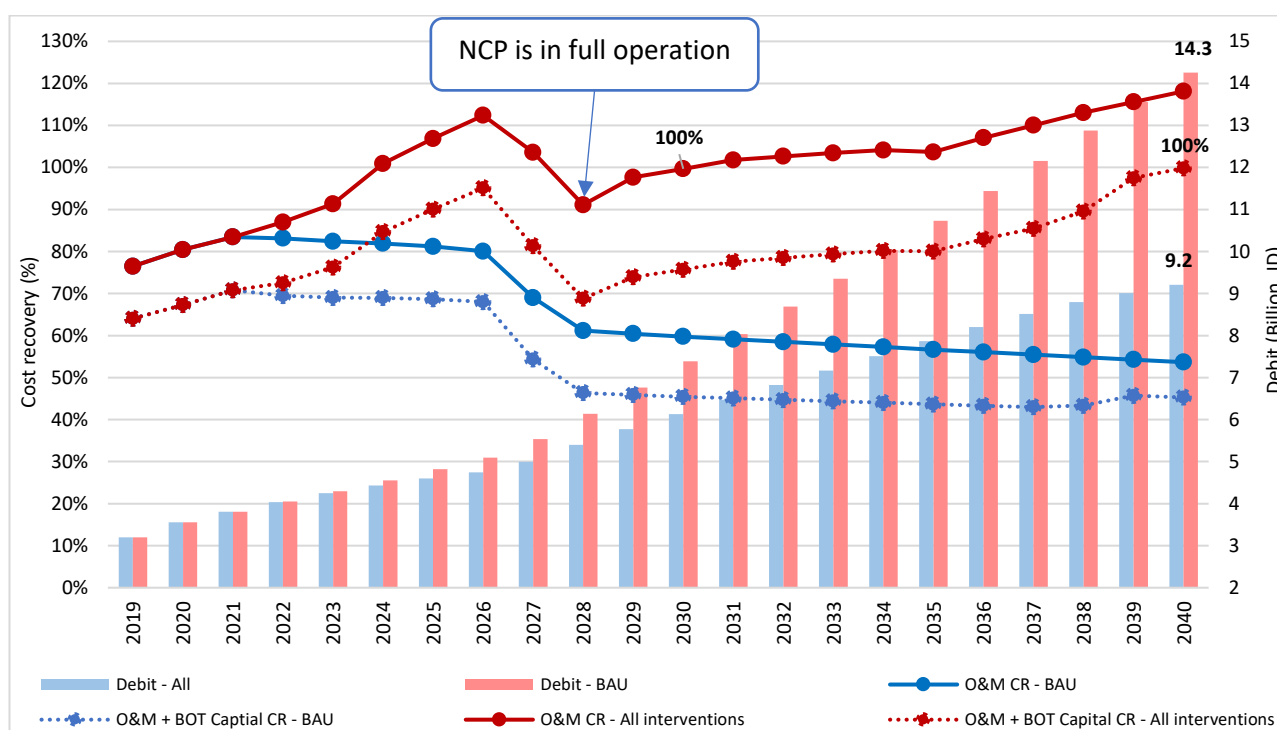
<sup>38</sup> In many cases, buildings connected to the wastewater system obtain work permits to add extra floors but do not pay the wastewater connection fees for these additional floors.

<sup>39</sup> Includes some expenses of Wadi Araba Company

Opportunities	Related Threats/Limitations
1. Reduce NRW	<ul style="list-style-type: none"> <li>a. Lack of technical and human capability</li> <li>b. Lack of proper incentives</li> <li>c. Shortage of financial resources for sustaining activities</li> <li>d. Absence of institutional enablers</li> </ul>
2. Increase flexibility in electricity supplies and shielding from rate volatility (Renewable Energy (RE), Energy Efficiency (EE), and indexation)	<ul style="list-style-type: none"> <li>a. Lack of technical and human capability</li> <li>b. Shortage of financial resources for sustaining operational activities</li> <li>c. Insufficient coordinated joint efforts between the water and energy sectors</li> </ul>
3. Improve maintenance of assets	<ul style="list-style-type: none"> <li>a. Shortages of financial resources and inadequate budget</li> <li>b. Lack of technical know-how</li> <li>c. Unplanned emergency responses</li> </ul>
4. Restructure revenues and improve connection rate to the wastewater networks and legalize illegal connections	<ul style="list-style-type: none"> <li>a. Unwillingness to impose additional financial burdens</li> <li>b. Reluctance of some beneficiaries to pay</li> <li>c. Weak regulatory enforcement</li> <li>d. Lack of qualified staff to support</li> <li>e. Lack of staff incentives</li> </ul>
5. Improve cash collections	<ul style="list-style-type: none"> <li>a. Weak and differentiated enforcement of regulations</li> <li>b. Lack of human and supporting resources and incentives</li> <li>c. High transactional costs of collecting arrears</li> <li>d. Weak performance and limited financial reporting</li> </ul>
6. Manage relation with MoF: timely transfers and debt management	<ul style="list-style-type: none"> <li>a. Transparency and Communication</li> <li>b. Performance and Financial reporting improvements (satisfying KPIs and covenants)</li> </ul>

## Future Financial Situation

The water and wastewater services are highly subsidized, which led to an increase in the total debit and support provided by the MoF to around JD 3.8 billion until 2021. If the situation continues to be as is, then the total debit of the sector will reach around JD 14 billion by 2040. However, with all the interventions planned to be implemented to reach the targeted cost recovery (CR) levels, including reducing NRW to 25% by 2040, enhancing energy efficiency including expanding renewable energy by 15%, and other revenue improvements as detailed in Goal 1, the sector debit will even reach around JD 9 billion by 2040, as shown in Figure 41.



**Figure 41: Financial Projection for Business as Usual (BAU) and All Proposed Interventions Scenario**

## Goal 1: Achieve Full Cost Recovery of Municipal Water and Wastewater Service Operations and Maintenance (O&M) And Build Operate Transfer (BOT) Costs

This goal focuses on having the municipal water and wastewater service providers (WAJ and its water companies) able to recover their capital cost, O&M and BOT costs, including the National Conveyance Project (the future desalination project), by 2040. The O&M costs include the O&M of retail services, the water resources development, and wastewater treatment either operated by the sector entities or by the private sector like the BOT contracts. Achieving this goal will ensure that the water and wastewater service providers can sustain their infrastructure and provide better services to the customers.

### Objectives

Goal 1: Achieve full cost recovery of municipal water and wastewater services, operations and maintenance (O&M), and Build-Operate-Transfer (BOT) costs				
Indicator/Target: Increase Municipal services recovery of O&M costs (including O&M cost for BOT) to 100% by 2030 and of O&M cost and BOT Capital charges to 100% by 2040				
Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 1.1:</b> Reduce NRW in the municipal water system	NRW quantity to water supplied ratio	52%	37% 25%	2030 2040
<b>Objective 1.2:</b> Increase energy efficiency and renewable energy initiatives to generate cost savings	% of energy efficiency and renewable energy savings to total consumption	0% (year 2019)	15%	2025
<b>Objective 1.3:</b> Allocation and optimization of sufficient funds for maintenance of assets	% Maintenance cost to asset value	0.25% <sup>40</sup>	3%	2025

<sup>40</sup> Estimated based on maintenance to assets value per 2021 financial statements

<b>Objective 1.4:</b> Regular update and review of tariffs and fee structures for all water and wastewater services to ensure equity and cost-coverage	Restructure revenues in an ongoing and progressive process to better reflect the costs of services provided, enable utilities to effectively finance required levels of O&M, while continue maintaining protections for the poorest households	From 2024
<b>Objective 1.5:</b> Reduce electricity tariff for water sector	Average electricity tariff is reduced as potentially possible in close coordination with MEMR	Continuous

## Strategic Approach

### *Optimize operation, maintenance, and BOT costs*

- Review annual financial budgets, and activate the architecture of cost and revenues centers, taking out off-balance sheet costs, and other information to better reflect the cost of service
- Prepare budgets for the medium term (3-5 years) and monitor deviations while actualizing the budget
- Avail suitable funds for maintenance
- Establish performance indicators to monitor cost optimization and better service such as the number of staff per connections, NRW, EE, etc.

### *Restructure revenues*

- Review existing level of water sector revenues, including water and wastewater tariff, and analyze areas for improvement and potential restructuring to better reflect cost of services
- Analyze and implement mechanisms to protect the poor
- Investigate feasibility and potential for monthly billing and indexation
- Analyze and study the groundwater abstraction fees structure and provide better monitoring and metering
- Investigate better mechanism to collect sewer tax that is carried out by the municipalities
- Restructure connection fees and enforce fees for extensions after issuance of work permits

### *Negotiate electricity tariff for the water sector*

WAJ and water companies consume more than 90% of electricity for water pumping purpose, where about 80% of it is used in five major water schemes: Disi water system, Zai Treatment Plant, Zara-Ma'in Treatment Plant, Wadi Arab Station, and Mafraq pumping system. Such major schemes are powered directly by National Electric Power Company (NEPCO), which can save around 15% of the electricity cost.

## Institutional Roles and Responsibilities, Resources, and Requirements<sup>41</sup>

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
<b>WAJ and Water Companies</b>	<ul style="list-style-type: none"> <li>- Provide information and support MWI in efforts to restructure revenues</li> <li>- Implement a scheme of continuous cost optimizations with gain/pain sharing</li> </ul>
<b>MWI</b>	<ul style="list-style-type: none"> <li>- Initiate and lead the efforts of restructuring revenues</li> <li>- Obtain support of Government of Jordan (GoJ), MoF, MoPIC, and others in restructuring revenues and the financial sustainability plan</li> <li>- Discuss, negotiate, and secure resources for cost optimization efforts</li> </ul>
<b>MoF</b>	<ul style="list-style-type: none"> <li>- Ensure providing the agreed financial support on time to WAJ and the water companies</li> </ul>

<sup>41</sup> It is assumed in this section that NRW reduction and Energy savings initiative (RE and EE) are not included here and are addressed in other sections



Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- Provide MWI/WAJ with qualified human resources to institutionalize data and information analytics for revenues restructuring options</li> <li>- MWI to negotiate and secure funding for cost optimizations and improved financial reporting initiatives</li> <li>-</li> </ul>	<ul style="list-style-type: none"> <li>- Investment in Enterprise Resource Planning (ERP) financial systems for an accrual-based integrated system</li> <li>- Capital funding for NRW, RE and EE</li> <li>- Allocation of funds for maintenance</li> </ul>	<ul style="list-style-type: none"> <li>- Data and information analytics system to support details for revenues restructuring, cost optimizations, etc.</li> </ul>

## Goal 2: Improve efficiency to reduce cost for the Operation & Maintenance of Irrigation Water Systems

Similarly, this goal aims to reduce O&M costs of irrigation services for retail and bulk water systems toward reducing financial deficit. The main contributors to achieve this goal are reducing water losses in the different irrigation water infrastructure, reducing energy cost and increasing revenues to better recover the O&M cost of service. By achieving this, JVA shall be able to sustain its irrigation and bulk resources infrastructure and provide better services to the farmers and other sectors.

### Objectives

Goal 2: Improve efficiency to reduce cost for operation & maintenance of irrigation water systems				
Indicator/Target: Reduce irrigation water systems' cost continuously				
Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 2.1:</b> Reduce water losses throughout the irrigation water systems	Volume of water losses in KAC (MCM/year)	49	18	2030
	Volume of water losses in irrigation water systems in the Jordan Valley (MCM/year)	37	15	2030
<b>Objective 2.2:</b> Optimize electricity use efficiency and expand using renewable energy	Convert to supply water by gravity and improve pumping performance to reduce energy consumption. Expand renewable energy projects including hydropower and exploit water dam energy storage			From 2023
<b>Objective 2.3:</b> Increase revenues to ensure equity and cost-coverage	Restructure revenues, including the development of land lease, sold hydropower prices, and link tariff with crops productivity, to better reflect the cost of services			From 2023

### Strategic Approach

#### Restructure revenues

- Analyze and investigate revenues, such as charges on bulk water sales, restructuring of hydropower rate and others
- Analyze and investigate potential to develop more lands for lease and investment
- Analyze and investigate potential to attract investors for development

#### Explore cost reduction options

- Optimize electricity efficiency of irrigation water systems
- Expand using renewable energy and storage of water dam energy
- Collaborate with famers to reduce operational cost of the irrigation water systems

## Institutional Roles and Responsibilities, Resources, and Requirements<sup>42</sup>

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
<b>JVA</b>	<ul style="list-style-type: none"> <li>- Provide information and support MWI in efforts to restructure revenues</li> <li>- Implement a scheme of continuous cost optimizations with gain/pain sharing</li> </ul>
<b>MWI</b>	<ul style="list-style-type: none"> <li>- Coordinate and lead effort on restructuring revenues</li> <li>-</li> </ul>
<b>MEMR</b>	<ul style="list-style-type: none"> <li>- Facilitate expanding the use of renewable energy and water dam energy storage</li> </ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- MWI/JVA need to be staffed with qualified staff to institutionalize data and information analytics for revenue restructuring options</li> <li>- Secure the necessary financing for the establishment of projects aiming at cost optimizations</li> </ul>	Investment in ERP financial systems for an accrual-based integrated system	<ul style="list-style-type: none"> <li>- Data and information analytics system to support details for revenue restructuring and cost optimizations</li> </ul>

## Goal 3: Improve Cash Management

In addition to improving cost recovery levels by reducing costs and increasing revenues, this goal aims to reduce the accounts receivable (arrears) on the sector customers and reduce additional interests, fines, and fees paid due to the delays in paying sector invoices. Better cash management should allow the water sector entities to have sufficient funds available to cover the day-to-day operational activities and thereby ensure effective service provision to customers and proper maintenance of water, wastewater, and irrigation infrastructures.

### Objectives

Goal 3: Improve cash management				
Indicator/Target: Reduce and sustain accounts receivable balances on all customers to be less than a billing cycle (or period according to regulations) and reach timely due payments by 2030				
Objectives	Indicators	Baseline (2021)	Target	Timeline
<b>Objective 3.1:</b> Reduce account receivables balance	Receivables balance of water and wastewater customers (mJD)	199	<100	2030
	Receivables balance of private wells (mJD)	136	<75	2030
	Receivables balance of revenues (mJD) for JVA	23	<10	2030
<b>Objective 3.2:</b> Eliminate additional interests, fines, and fees for delays on cash outlays (electricity, BOT payments, etc.)	Strengthen cash management procedures and coordination with the governmental entities including Ministry of Finance, Energy and Mineral Regulatory Commission (EMRC), etc. to eliminate all additional interests, fines, and fees for delayed payments from 2025			From 2025
<b>Objective 3.3:</b> Ensure timely transfers from the Ministry of Finance and apply central debt management procedures	Eliminate delays in government cash transfer and reduce annual service payments on water sector debt			From 2025

<sup>42</sup> It is assumed that NRW reduction is addressed in other sections

## Strategic Approach

### *Maximize cash position in entities*

- Incentivize cash collections (discounts for customers on early payment, penalties on customers for late payments, balanced incentives for collection staff, etc.)
- Establish reporting system on the aging of receivables, penalties, discounts, etc. to support the objectives

### *Manage interface with MoF*

- Agree on a financial sustainability plan with MoF
- Establish a mechanism to ensure timely transfer from MoF, such as enhancement of coordination
- Investigate ways to create working capital in cases of forced delays of transfers
- Hand over the legacy debt to MoF for better management and potential refinancing options

## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key institutional roles
<b>WAJ and Water companies</b>	<ul style="list-style-type: none"><li>- Propose incentive schemes to maximize cash flow</li><li>- Negotiate grace periods with vendors and contractors</li><li>- Communicate public campaigns on incentives</li><li>- Establish clear and transparent disciplined cash waterfall</li><li>- Improve debt recovery to reduce receivable balance</li></ul>
<b>JVA</b>	<ul style="list-style-type: none"><li>- Improve debt recovery to reduce receivable balance</li></ul>
<b>MWI</b>	<ul style="list-style-type: none"><li>- Coordinate with MoF mechanism for timely transfers</li><li>- Create central unit to develop projects and coordinate donors support</li></ul>
<b>MoF</b>	<ul style="list-style-type: none"><li>- Positively respond to timely transfers, or otherwise provide options to avoid delay fines and cascading effects to delays</li><li>- Support management of legacy debt and accumulation thereof</li></ul>

### *Human and Financial Resources and Requirements*

Human resources	Financial resources	Requirements
<ul style="list-style-type: none"><li>- Staff the water sector with qualified individuals for project development and appraisal</li><li>- Expert support to carefully structure incentives and waterfall schemes</li></ul>	<ul style="list-style-type: none"><li>- Working capital in case of delayed transfers from MoF</li></ul>	<ul style="list-style-type: none"><li>- Legal institutional enablers</li></ul>

## Monitoring and Evaluation

The Finance Directorates within MWI, WAJ, JVA and each of the water companies, will be the owners of these goals and their related objectives and will be responsible for following up with other units and departments on the status of progress toward achieving them. These directorates will develop and approve periodic reporting systems (either quarterly or annually) to assess progress in achieving the goals and objectives.

Within the water sector, the UPMU (or the future regulator), as well as MWI, will follow up with WAJ, JVA, and the water companies on the progress of the goals.

## Conclusion

Securing more funds and investments into the water sector is crucial but is not the sole objective. This strategy aspires to improve the financial health of the sector and promote its sustainability as a means to look beyond money and instead enable enhanced service standards and quality, efficiency in its provision, and improvements to the governance of the water sector.

Achieving these cost recovery commitments for WAJ, JVA and water companies will help all sector entities be less dependent on government subsidies and/or foreign subsidies. This is critically needed to improve and sustainably operate and maintain the systems. Otherwise, the sector will be continuously captive to fluctuations in electricity rates and restrictions imposed by the annual government budgetary cycle. This independence will result in better service provision that will in turn lead to better willingness to pay from users. The cycle of funding challenge for service provision and management efficiency will be interrupted and replaced with the financial sustainability one.

## 8 SECTOR GOVERNANCE AND INSTITUTIONAL DEVELOPMENT

A pillar goal for the sector is to “reform the legal and institutional framework to modernize the sector, clarify roles and responsibilities, enhance accountability, and increase public trust”. This chapter addresses the specific goals, objectives, strategies, and targets to meet and achieve this. This is to ensure that the water sector is perceived to be effective and responsive, with clear organizational mandates for water authorities, independent utility companies, well-regulated services, and good governance. Achieving this pillar goal requires a thorough examination of existing governing laws, bylaws, functions, and responsibilities to identify the needed reforms. This includes an examination of where the current framework has created gaps, overlaps, conflicts, or is simply no longer appropriate for the needs of the sector today which require that water services become financially viable and significantly more efficient, reliable, and responsive to customer needs.

This chapter addresses the sector’s specific priorities, goals, and strategies for strengthening water sector governance through continued implementation of ongoing sector reforms, sector restructuring, and critical institutional development activities. Sector governance encompasses how the legal, policy, and institutional structures, roles, responsibilities, incentives, and administrative mechanisms across the sector work to effectively manage water resources, deliver water and wastewater services, and ensure that the sector is responsive, and accountable. The reason that sector governance is a pillar goal is that evidence around the world, as well as in Jordan, has demonstrated that sustainable water security is simply not possible without good governance.

As was reinforced in the 2022-2033 Economic Modernization Vision, these responsibilities are entrusted to a multi-institutional public service entity (MWI) accountable to the public as a government entity. It has been guided through this vision to consider “adopting comprehensive plans and programs with clear goals and KPIs, operating transparently, clarifying its work mechanisms openly and responsibly, to dispel destructive rumors with convincing facts and replace futile argumentation that feeds on the lack of information with informed debates.” The vision has also focused on accountability, being “a must for those who are derelict in performing their duties towards citizens, for public service is about offering solutions, not placing obstacles before citizens.”<sup>43</sup>

The ambitions of the 2022-2025 Public Sector Modernization Vision, are “a governmental structure that is designed to serve the priorities of the citizen and comply with the foundations of good governance to enhance transparency, oversight and accountability”, and “achieving an agile, uncomplicated, integrated and efficient organizational and government structure, that is citizen-centric”.<sup>44</sup>

### Current Situation

Management of the water sector is facing intense pressures due to several technical, administrative, legislative, and financial causes. In the context of such severely limited water resources, worsening water quantities and quality, high water losses, significant demographic changes, and noticeable climate change impacts, these scarce resources are under increasing threat. Water and wastewater service levels vary across cities, towns, and even neighborhoods with widespread customer dissatisfaction and continued erosion of public trust. Such variations are also attributed to limitations and variability in supplies, additionally stressing the need for effectively managing the resources, and the availability of the right institutions, resources, and capacity to manage the sector.

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<sup>43</sup> Economic Modernization Vision, Royal Message (jordanvision.jo), January 202 ,302

<sup>44</sup> Public Administration Modernization Vision, Public Sector Modernization Road Map, Governance and Organizational Structure Concept Note, 2022

## Institutional Framework

There are several public and private institutions with key roles and responsibilities for sector governance:

### *Ministry of Water and Irrigation (MWI)*

MWI, based on its Administrative Regulations bylaw No. 52 of 1992<sup>45</sup>, is the official body responsible for the overall monitoring of the water sector, water supply and wastewater systems and related projects, planning and management, formulation of national water strategies and policies, research and development, and information systems and procurement of financial resources. Its role also includes the provision of centralized, standardized, and consolidated water-related data.

The establishment of the Ministry of Water and Irrigation was in response to Jordan's recognition of the need for a more integrated approach to national water management, clearly delineating the separation between developing the water policies and executing the operations. Despite these extensive sector-level responsibilities, MWI has more limited legal authorities than WAJ and JVA, and there are some kind of overlaps between MWI's responsibilities and WAJ and JVA's responsibilities.

### *Jordan Valley Authority (JVA)*

JVA was established in 1977 with responsibility over the socioeconomic development of the Jordan Rift Valley including the development, utilization, protection, and conservation of water resources. While this mandate remains, since this time the JVA's role has shifted emphasis to now be primarily focused on managing the water resources within the Jordan Valley which encompass the dams to manage river flows and seasonal runoff, bulk irrigation water, distribution, and drainage systems, the King Abdullah Canal (KAC), and development of irrigation lands. The KAC, which is constructed alongside the eastern side of the Jordan River, is a major irrigation canal and transports water from the North of the Valley. It is downstream to water coming from highlands and dams constructed on the eastern wadis.

### *Water Authority of Jordan (WAJ)*

WAJ was established in 1983 as a semi-autonomous government entity with broad authorities in charge of water and wastewater management. These responsibilities include investment, ownership, and management for: bulk water development, water treatment, water utility services, sewer systems, and wastewater collection and treatment. Most water and wastewater services have been assigned to the three water service companies: **Aqaba Water** in the south, **Jordan Water Company (Miyahuna)** in the middle, and **Yarmouk Water Company** in the north. WAJ retains ownership of the country's water and wastewater infrastructure.

### *Water Utility Companies*

Aqaba Water, Miyahuna, and Yarmouk water companies were each established to operate on a commercial basis governed by the Companies Law. Tailored Assignment Agreements with WAJ assign each the authority of WAJ over all water and wastewater service functions within its designated areas, except where such authority is governed by contracts with third parties, specifically in Disi water supply and As-Samra wastewater treatment plant BOTs. The objective of devolving water and wastewater services to companies was to enable the companies to leverage the flexibility and efficiencies that can accrue as a private sector company. This has been successful to varying degrees, however, as over time the government has continued to play a significant management role and applying its regulations, resulting in the water companies becoming more like O&M companies with continued erosion of autonomy.

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<sup>45</sup> Ministry of Water and Irrigation (jordan.gov.jo), June 6, 2022

### *Other Water Entities*

Some internal sub-entities within the governance structure also play a significant role in sector governance. **Water Users Associations (WUA)** were established across the Jordan Valley. These associations of local farmers were established by JVA as a partner to improve irrigation management. WUAs can be assigned responsibility for irrigation water distribution to individual farmers. The WAJ **Program Management Directorate (PMD)** at WAJ has primary responsibility for managing part of the infrastructure projects funded by donors and As Samra BOT. The **Utilities Performance Monitoring Unit (UPMU)** was established to monitor the performance of the three public water service companies. The UPMU is intended to provide a level of regulatory oversight in the hopes that these functions could be steadily and rapidly strengthened to pave the way for the establishment of independent sector regulation.

### *Key Stakeholders*

At the national level, government stakeholders include the Ministry of Finance (MoF), Ministry of Planning and International Cooperation (MoPIC), Ministry of Agriculture (MoA), Ministry of Health (MoH), Ministry of Environment (MoEnv), Ministry of Tourism and Antiquities (MoTA), and the Ministry of Energy and Mineral Resources (MEMR). Water is fundamentally important beyond the government as well, and other major stakeholders include academia, research institutes, business interests, the donor community, and NGOs.

### **Legal Framework**

The sector is governed by a complex, and at times contradictory, set of major water laws, bylaws, policies, and regulations. Laws have the most legal authority over sector management and operations. For the water sector, the most significant legal framework derives from the following three laws:

- Water Authority of Jordan Law No. 18 and Amendments of 1988 which established WAJ and its legal roles, rights, and responsibilities, amended over time.
- Jordan Valley Authority Law No. 19 and its amendments of 1988 which established JVA and its legal roles, rights, and responsibilities, amended over time.
- Ministry of Water and Irrigation Bylaw No. 14 of 2014 that describes MWI's organizational structure and clarifies its responsibilities and roles.
- Underground Water Control Bylaw No. 85 of 2002 that describes and entails the different procedures that are needed for controlling groundwater resources in Jordan.
- Jordan Valley Authority Administrative Bylaw No. 27 of 2022 that describes the organizational structure of JVA and its roles and responsibilities.
- The National Water Policy Advisory Council Bylaw No. 54 of 2011 established the Council chaired by the Minister, which is an advisory body to MWI.

The sector is required to operate in compliance with a wide range of regulations from within and outside of the sector. These regulations include the following: Regulation No. 76 for Groundwater Protection and its amendments (2003), Wastewater Regulation No 66 (1994), Subscribing to Drinking Water Regulation No 67 (1994), Regulating and Controlling Irrigation Water Use Instruction for year 2003, Jordanian Standard No. 893 Water- Reclaimed Wastewater (2002), Jordanian Standard No 287, Drinking Water – Method of Sampling (1998), Jordanian Standard No. 286 on drinking water quality, Drinking Water Standards (1997), Jordanian Standard No. 1145 on applying treated sludge, Using Sludge in Agriculture (1996), and Administrative Regulation No. 54 of MWI and the amendments of those regulations and standards. Most of these regulations relate to water quality, wastewater treatment, and sludge management quality, testing, and reuse requirements.

Finally, the sector manages most of its institutions for financial and administrative independence through a range of specific policies, plans, strategies, and regulations to ensure that everyone within the sector has a clear understanding of the overall vision, and specific actions needed to achieve sector goals. In the past several years, there has been a major effort to update this policy framework and develop corresponding



action plans that provide clear, measurable, and time-bound implementation plans to tackle the major issues facing the sector. The planning and policy documents are not legally binding, but they are very important sector management tools, ensuring clear guidance and directives.

Since the legislative framework is based on the laws that established the sector's institutions, significant challenges have been created in ensuring that sector reform, water resources management, and oversight needs are addressed at a holistic cross-sector level. There have been several different efforts over the past ten years in attempts to develop a comprehensive Water Law with no success.

Timely enough, however, among the strategic goals of the 2022-2025 Public Administration Modernization Vision, "developing the current system of legislation, laws and regulations, especially with regard to responsibilities, roles and bodies concerned with following up on the enforcement of laws" has been prioritized.<sup>46</sup>

## Human Resources

The water sector has continued to struggle to attract, train, develop, and retain staff with the right qualifications to meet the rapidly changing demands of planning for and effectively addressing Jordan's water scarcity and optimizing its national water systems and the level of services. Water entities' staff needs to be enabled to professionally manage a modern, efficient water sector that is held accountable in achieving its strategic goals, makes its decisions and operates based on accurate and verified data, data analytics, process automation, commercial principles, private sector participation, sound planning, and continuous improvement against a clear vision and according to measurable KPIs. The sector has seen a steady siphoning off talented and experienced staff because of brain drain and mandatory retirements, while being unable to rebuild and develop the next generation of water sector leaders due to halting recruitment. Hiring is regulated by the Civil Services Bureau, which has outdated and overly prescriptive requirements that do not allow for the flexibility required to recruit the much wider range of expertise needed beyond engineering such as finance, communications, IT, management, contracts, and marketing.

## Sector Structure

The current structure of the sector institutions shows challenges in the legal, technical, and financial relations between them and the need to address the gaps, overlaps in functions and roles, and conflicts of interest among them. Within each water entity, organizational development and restructuring plans rarely address the corresponding execution and staff training and development needed for evolving functions, staffing, and systems.

Sector reform efforts have been slowly implemented over the past ten years. This work is important and necessary, but the pace and extent of reform needs to be accelerated to ensure that the sector can transform into the modern, responsive, and evidence- and commercial-based entities needed to achieve water sector and financial sustainability. Sector restructuring must be based on the following core results:

- Separate the legal, operational, and management responsibilities for bulk water supply from retail water and wastewater services for municipal and irrigation water.
- Ensure that water companies have the independence and enabling environment to function as commercial entities, within amended assignment agreements, legal frameworks, well-defined accountability systems, and efficient, modernized methodologies and automated processes that together support the implementation of its duties in a way that contributes to achieving the higher strategic goals of the sector as a whole, relevant national goals, in addition to those related to sustainable development.
- Independent regulation of water and wastewater services and cost of services.

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<sup>46</sup> Public Administration Modernization Vision, Public Sector Modernization Road Map, Governance and Organizational Structure Concept Note, 2022

- Consolidated sector-level planning and oversight within the MWI.

## Women in the Water Sector

The 2018 Gender Study that the percentage of females in water sector institutions<sup>47</sup> represents about 11% of water sector staff; in WAJ and the water utilities it ranges between 8% and 13% while in MWI females constitute 32% of staff, and in JVA 8.8% of staff are females. Notably, when excluding the lowest job categories in WAJ and the water companies which accounts mainly for the operational and field staff, the percentage of women rises to 43%.

MWI has a well-established Gender Unit responsible for strengthening women's participation in the sector as a vital component of development and performance improvement. Despite this, there is still significant work to be done to fully enable effective gender inclusion through capacity building programs which enhance gender equity and representation in leadership and decision-making.

## Key Challenges, Considerations, Opportunities, and Threats

The water sector has seen significant structural changes to its operating environment, water supplies, operating costs, fiscal position, and water demand due to several factors like the COVID pandemic, climate change, changes in national priorities, and the financial situation. These factors have reinforced the need to accelerate sector reforms and restructuring, as the current institutional and legal framework does not enable the sector and its water entities to adapt, anticipate, and effectively manage with the speed, scope, and scale of these changes. Good sector governance in Jordan faces several challenges and key considerations which are outlined below.

**Institutional framework.** The current breakdown of water entities and their corresponding responsibilities does not work to achieve the goals for the sector. Restructuring is needed to transform the current water entities into bulk water suppliers, corporatized O&M utility companies, independent agricultural retail associations, and an overarching planning and management authority that works to protect, manage, allocate, and sustain all water resources as national resources. This must be complemented with an independent regulator to achieve strong accountability and transparency throughout the sector.

**Lack of regulation.** Regulation of services and sector performance is a core component of a well-managed water sector. It is also a known fundamental principle of regulation that you cannot regulate yourself, as there is an inherent conflict of interest in overseeing your own performance. Currently, not only is the UPMU the only unit with any regulatory responsibilities, but its role is limited to reporting on a set of KPIs for the utilities and providing recommendations for improvement. As such, there is an urgent need to strengthen regulation to have independent, reliable, and available reporting on utility services, financial performance, and sector operating costs. Effective regulation and accountability also serve a very valuable role in enhancing performance and strengthening public trust.

**Financial and commercial management.** The sector has very clear goals and priorities to reach financial sustainability, while achieving this requires more than restructuring tariffs and improving operational efficiencies to see cost savings. It requires qualified and sufficient staff within the water entities to have the established management systems, capacity, and experience to reduce losses and strengthen accountability and financial controls. In addition, the water companies are not given independence in financial management. For example, their proposed budgets are negotiated with the General Budget Department, despite being established under the company's law. These budgets are then reviewed and reduced by budget

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<sup>47</sup> The 2018 Gender Study on Women Working in the Water Sector identified some limitations in data collection and data management which made comparative analysis more difficult as the six water sector institutions (MWI, WAJ, JVA, YW, AW and Miyahuna) used different systems for classifying and managing data.

department staff with no sufficient insight into status of the water sector operational challenges, and the lowered allocations then reduce O&M spending for maintenance of assets.

**Staffing.** Many functional areas within the sector suffer deficiency in experienced staff, while the sector is unable to hire, transfer, and fire them when needed, and lacks the flexibility in determining competitive salaries that can attract the required competencies due to the restrictions imposed and obligating the institutions and companies of the sector to carry out these tasks according to the civil service regulations.

**Management systems.** Despite the new ERP systems being rolled out at WAJ and the water companies, with extensive training and institutional development support, it remains insufficiently utilized. And as this system has been shown to greatly improve performance data collection and analysis and provide high level reporting across technical, operational, and financial areas for managers and decision makers, the sector needs to fully optimize the ERP system within its institutions and departments, especially the ones that can perform quick and reliable analysis.

**Data-driven decisions.** Governance requires information to manage, adapt, and ensure responsiveness and transparency. Currently, the needed data is scattered throughout each entity. There is weak central monitoring of this data, which weakens accountability on whether data is submitted on time, or not. Therefore, the sector is making resource management decisions that have huge and long-term financial and sustainability implications, with the absence of accurate, timely, and reliable data.

**Gender and inclusion**<sup>48</sup>. Women remain insufficiently represented in leadership positions and requires more work to ensure giving equal opportunities in hiring, retention, compensation, promotion, and capacity building opportunities. Data and plans in the sector are still not fully gender disaggregated and gender sensitive. In terms of other areas of inclusion, youth and persons with disabilities in the workforce present a unique set of both challenges and opportunities. The water sector minimally complies with government regulations<sup>49</sup> regarding the inclusion of persons with disabilities (PWDs) and there needs to be concentrated efforts to target hiring PWDs across the sector wherever possible<sup>50</sup>.

Despite all the explained challenges, there are good opportunities related to the **Complementary Government reform efforts**. The national government has a renewed focus to promote transparency, empower citizens, enhance communications, and harness new technologies to strengthen governance. The Public Sector Administration Modernization Committee was formed in 2021 as a national initiative “aimed at improving the quality of services provided to citizens and raising the efficiency and effectiveness of public sector institutions.” MWI is one of the ministries that are included in this initiative, and the goals of this strategy are aligned with the initiative’s priorities and roadmap. This creates a powerful opportunity to align long overdue and difficult sector reform initiatives to this broader government effort with the support of the Prime Ministry and other key government institutions.

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<sup>48</sup> Gender Study on the Women Status Working in the Water Sector, USAID Water Management Initiative, 2018.

<sup>49</sup> The law states that organizations of 25 to 50 employees should have at least 1% PWD employment and organizations with over 50 employees should have 4% PWD employment.

<sup>50</sup> The *Gender Study on the Women Status Working in the Water Sector* reported there were around 9,359 total employees in 2018. A rapid assessment carried out by the MWI Gender Unit in 2022 determined that only 47 PWDs were employed across WAJ, JVA, MWI and the three water companies, less than 1% for the whole sector.

## Goal 1: Restructure and Modernize Water Institutions to Ensure That They Have the Legal Mandates, Staff Capacity, Resources, and Incentives to Enhance Accountability and Increase Public Trust

The sector will move forward with institutional and legal restructuring to clarify, separate, and distinguish the key functional responsibilities and roles for the sector, of which the most important ones are those related to water resources management, water production, transmission, distribution, and regulation. This will enable much more streamlined and integrated sector management with clear oversight and public reporting to increase transparency and accountability. Through restructuring and separating government interference from utility companies, there will be stronger service delivery and commercial management mandates to improve customer service and financial performance. This will rebuild public trust through action, better and more reliable services and information, and regular and reliable performance reports from an independent regulator.

### Objectives

Goal 1: Restructure and modernize water institutions to ensure that they have the legal mandates, staff capacity, resources, and incentives to enhance accountability and increase public trust		
Indicator/Target: The water sector is perceived to be effective and responsive, with clear organizational mandates for water sector entities, independent utility companies, well-regulated services, and good governance		
Objectives	Indicators/Targets	Timeline
<b>Objective 1.1:</b> Update legal and institutional structures for all water entities to enact sector reform and restructuring	Update laws and bylaws to separate bulk water production from retail services, ensure utilities are independent, establish independent regulation, and consolidate sector policy and oversight in the MWI	2025
	Update and enforce Assignment Agreements with water companies and their functions in accordance with the Articles of Association and applicable provisions of the Company Law, in order to clarify legal rights, institutional responsibilities, financial obligations, and regulatory requirements	From 2024
<b>Objective 1.2:</b> Regular and reliable public reporting on sector performance, and water and wastewater service levels	Annual Report published by the Ministry of Water and Irrigation within three months of the end of the year to assess progress against achieving goals of the National Water Strategy, SDGs, and government priorities	From 2024
<b>Objective 1.3:</b> Expand public participation to build citizen partnership	Establish regular public engagement platforms to discuss major policy priorities and solicit input into annual sector planning processes	From 2023

### Strategic Approach

**Legal framework update and development.** Sector restructuring will require a holistic review and amendment of existing laws, bylaws, and policies that are taken as a whole to allow for the changes needed across all water entities. WAJ and JVA water development responsibilities will be separated out to form bulk water supply entities with all retail responsibilities passed on to utility companies or irrigation associations. Assignment Agreements and Articles of Association for the water companies must be updated in parallel with this effort to ensure that their corporate responsibilities are clearly delineated and defined. The MWI must be empowered to carry out its responsibilities in formulating policies, national plans, water resources management and monitoring, and managing donor funding and attracting investments. Alongside these reforms to existing entities, the sector will work on establishing an independent regulatory body that regulates the sector and monitors the level of water and wastewater services and provide its recommendations in relevant financial and tariff matters. The changes to the proposed legal framework must

then be executed through comprehensive institutional development plans accompanied with significant training programs to staff and improvements to new operations and systems that will be activated.

**Performance reporting.** The water sector must report on the overall performance evaluation against the National Water Strategy targets, SDGs, and national priorities. This reporting is beyond just utility services reporting, which is a regulatory function. Instead, this reporting is the responsibility of MWI, as the national party tasked with looking at the overall health and ability of the sector to meet the needs of the public and the imperatives of sustainable water security. It is essential that MWI releases an annual report to the public along with regular formal and informal progress reporting.

**Public participation and engagement.** Water is the concern of every person within Jordan. The sector must expand public participation in the planning process to ensure that key public needs are heard and addressed in national water budgets, especially those of marginalized and underrepresented groups. The sector should also increase citizen access to information, analysis, policy documents, and accessible materials to support improved understanding of the public and easy engagement of key stakeholders.

## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
GoJ	<ul style="list-style-type: none"> <li>- Enable establishment of the regulatory body</li> <li>- Ensure proper functioning and independence of the regulatory body in carrying out its missions</li> <li>- Propose legal reforms and work on their endorsement</li> </ul>
MWI	<ul style="list-style-type: none"> <li>- Adopt strategic planning in the sector reform process</li> <li>- Expand sector-level reporting and public engagement</li> <li>- Propose amendments on current legislations or propose new laws</li> </ul>
Parliament	<ul style="list-style-type: none"> <li>- Review and approve proposed reform legislations</li> </ul>
MWI, WAJ, water companies, JVA	<ul style="list-style-type: none"> <li>- Work closely throughout the sector reform process to co-develop and update strategies and action plans for sector reform, agree on sector wide KPIs, and integrate investment planning</li> </ul>
WAJ and water companies	<ul style="list-style-type: none"> <li>- Update, implement, and comply with Assignment Agreements and Articles of Association</li> <li>- Provide accurate performance data on-time to regulator</li> </ul>
Donors	<ul style="list-style-type: none"> <li>- Build capacity on result-based strategic management and planning</li> <li>- Conduct a sector wide governance assessment</li> </ul>
Regulator	<ul style="list-style-type: none"> <li>- Agree on and monitor performance against KPIs and targets</li> <li>- Collaborate with water institutions to develop Monitoring, Evaluation and Learning (MEL) plans and reporting mechanisms</li> <li>- Annually determine actual cost of water and recommend governmental subsidy levels based on the actual cost and financial targets</li> <li>- Report publicly on sector performance</li> </ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- Conduct change management programs to raise staff's awareness and introduce them to their responsibilities and roles in institutional reform and sector restructuring</li> <li>- Organizational development and capacity building for new roles, processes, and operating in new structure</li> </ul>	<ul style="list-style-type: none"> <li>- Capacity development and training budgets in all water entities</li> <li>- Allocation of financial resources to cover cos of establishing the proposed regulatory body</li> <li>- Donor support to reform and build capacity</li> </ul>	<ul style="list-style-type: none"> <li>- Political will to finalize and pass comprehensive legal reforms</li> <li>- Available human and financial resources</li> <li>- Successful capacity building conducted and sustained</li> <li>- Administrative stability of top management</li> </ul>

## Goal 2: Strengthen the Organizational Structures and Management Practices within Water Institutions to Be Responsive and Resilient to Dynamic Sector Management Needs

In general, the public sector, including the institutions of the water sector, is suffering from weak responsiveness and resilience in processes and decision making, despite being imperative for the sector's institutions. The needs and nature of activities of the sector are changing, and the organizational structures and management institutions must respond at the required speed and adapt to this change accordingly. This change must start with amending the hiring and human resources management practices. Incentives across the sector, for water companies as well as water entities, must become aligned with performance in a fully accountable and transparent manner. The sector must again be able to rebuild its ranks, attracting early career professionals and steadily building the next generation of sector leadership that is equipped for the dynamic nature of the current and future water sector. All of this must be accompanied by much more deliberate, extensive, and routine capacity development, training, and institutional development.

### Objectives

Goal 2: Strengthen the organizational capacity and management practices within water institutions to be responsive and resilient to dynamic sector management needs		
Indicator/Target: Sector staffing is aligned to functional needs with appropriate capacity, training, resources, and a clear path for professional development and advancement on the basis of performance		
Objectives	Indicators/Targets	Timeline
<b>Objective 2.1:</b> Attract and retain qualified and inclusive staff throughout the water sector who are empowered and incentivized to perform at a high level	<ul style="list-style-type: none"> <li>- Effective deployment and attraction of qualified staff who match the required experience levels, technical expertise, and performance to carry appropriate roles, responsibilities, and advancement opportunities</li> <li>- Performance management systems and incentive schemes that regularly review and reward staff performance against clear goals and targets</li> </ul>	Urgent and ongoing
<b>Objective 2.2:</b> Update hiring procedures, organizational charts, human resources policies, position descriptions, and staff performance management to ensure high quality, accountable, and well-run institutions	<ul style="list-style-type: none"> <li>- Hiring procedures are transparent, impartial, and updated to reflect new technical needs for the sector</li> <li>- Accurate organizational charts in place for each of the water sector institutions, reflecting its policies and regulatory mandates</li> </ul>	From 2024
	<ul style="list-style-type: none"> <li>- Succession planning and continuity of hiring practices to fill critical roles and develop long-term leadership capacity</li> </ul>	From 2025
<b>Objective 2.3:</b> Attract youth, women and PWD to work at the sector	<ul style="list-style-type: none"> <li>- Equality in recruitment of women and allowing opportunity for underrepresented groups to increase their share of the workforce to 40% by 2040</li> </ul>	Ongoing
<b>Objective 2.4:</b> Invest in placing and maintaining staff training and capacity development, particularly in critical areas of project management, contracts management, climate change, NRW, financial management, and PSP	<ul style="list-style-type: none"> <li>- Give a pioneering role to the Water Authority of Jordan Training Center and leadership to all sector staff training programs. Training programs established, ranked, updated and linked to staff advancement</li> </ul>	From 2024
<b>Objective 2.5:</b> Strengthen corporate governance and leadership skills across all water sector entities	<ul style="list-style-type: none"> <li>- All water utilities to adopt business basis in annual planning and performance management against KPIs with annual public reporting.</li> <li>- MWI to manage sector master plans, Strategy Implementation Framework (SIF), and the national strategy goals with annual public reporting</li> </ul>	From 2024



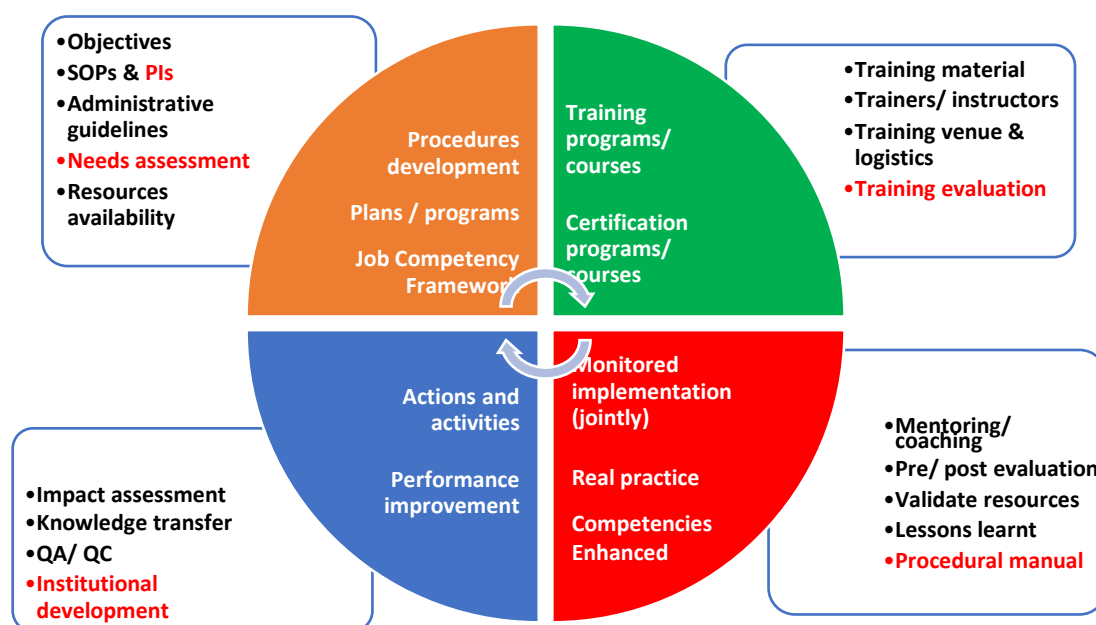
<b>Objective 2.6:</b> Strengthen internal communication and sector-level coordination across all water sector entities	- High level of awareness and engagement among all sector staff in the development of policies, strategies, major reforms, sector restructuring plans, and other major issues affecting overall operation and management of the sector	From 2024
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## Strategic Approach

The objectives and indicators for this goal are very straightforward. The strategic approach to execute and achieve them is also straightforward. Sector leadership and managers across the sector must change the way in which staff and management are selected and hired, and in developing procedures of their management, incentivizing, rewarding, and advancing them.

**Human resources systems and processes.** Implement structural changes to human resources with a renewed commitment to training and professional development. Specific requirements and conditions must become requirements for certain jobs and advancement with the requisite trainings being offered to create an even playing field for promotion. Each entity needs updated organizational charts aligned to the NWS and key sector commitments, through which clear job descriptions and standard operating procedures are outlined. Capacity development to ensure that staff can fulfill their assigned roles needs to be addressed within an integrated capacity development system (see Figure 42).

**Succession planning.** The sector needs to work closely with relevant stakeholders to remove hiring restrictions and job replacement so that to help rebuilding units, departments, and institutions, and to provide long-term job succession options, as well as to provide the sector with competencies of modern science and practices.



**Figure 42: Capacity Development System**

**Training.** Regular training in management and operations skills must be developed, as the newly refurbished WAJ Training Center is an ideal venue for staff trainings for all water entities and companies.

**Corporate governance.** Sector management needs further professional development in the principles and institutionalization of good corporate governance principles as another key component in building a responsive and resilient water sector.



## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
Governmental Institutions concerned in hiring	<ul style="list-style-type: none"><li>- Support sector in hiring of staff needed</li><li>- Delegate needed authority regulation including recruitment and procurement</li></ul>
MWI WAJ JVA Water Companies	<ul style="list-style-type: none"><li>- Implement the restructuring related to updating organizational charts, roles and responsibilities, job competency and job descriptions, etc.</li><li>- Develop human resources relevant plans, procedures, and guidelines</li><li>- Develop capacity building plans and trainings, including skills development in corporate governance and leadership</li><li>- Develop and implement quality assurance/quality control mechanisms and performance monitoring tools</li></ul>
Donors	<ul style="list-style-type: none"><li>- Align support to human resources and capacity development priorities</li></ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"><li>- Trained Human Resources (HR) staff</li><li>- Training technical staff</li><li>- Develop and implement job replacement plans</li></ul>	<ul style="list-style-type: none"><li>- Providing financial resources</li><li>- Training budgets</li></ul>	<ul style="list-style-type: none"><li>- Leadership commitment to new HR systems and structures</li><li>- Civil Service Bureau support</li><li>- Release hiring constraints</li></ul>

## Goal 3: Strengthen Sector-Level Strategic Planning, Management, Monitoring, Evaluation, and Reporting

The complexity and interconnected nature of Jordan's water resources, coupled with the added challenges from the extreme water scarcity and changing composition and contributions from different and new supplies, such as desalination project that requires high investment levels, makes it essential that there is strong planning and management, in paired with effective and routine monitoring and evaluation of management metrics and progress against plans and strategy targets to create incentives for performance and accountability across the sector. The sector will invest in developing systems and building staff capacity to integrate robust and reliable data into sector and institution-level planning and strategies, as well as regular updating of capital investment plans and linkages with the master plans, as an essential tool to better advocate and coordinate across the government for water sector priorities.

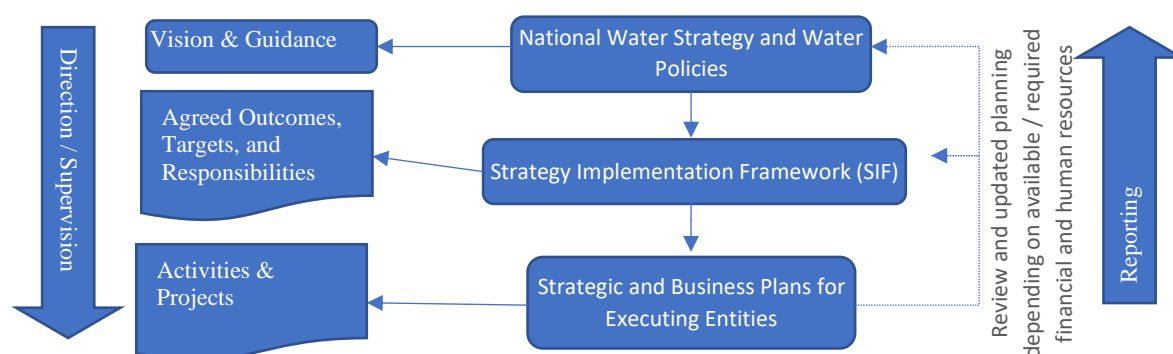
The sector will work on developing well-informed, results-based, and time-bound action plans that keep pace with developments, and link to a well-structured Monitoring, Evaluation, and Learning (MEL) system. Reliable data, information sharing, systems compatibility, and clear responsibilities for collection and reporting are all pre-requisites for the success of this strategy. Timely reporting allows for progress analysis, dynamic adjustments and updates of strategic decisions, and future planning. It also results in accurate and evidence-based identification of challenges and opportunities for increased responsiveness.

## Objective

Goal 3: Strengthen sector-level strategic planning, management, monitoring, evaluation, and reporting		
Indicator/Target: Sector strategies and plans are updated and implemented against clear milestones, targets, and indicators		
Objectives	Indicators/Targets	Timeline
<b>Objective 3.1:</b> Manage water sector institutions according to corporate governance principles on the basis of results-based plans and performance management against targets	Strategy Implementation Framework (SIF) are developed and institutionalized as a management framework within each water sector entity	From 2023
<b>Objective 3.2:</b> Institutionalize the monitoring and evaluation procedures within all institutions and reflect them as annual plans and budgets	<ul style="list-style-type: none"> <li>- Reliable water resources data and operational indicators are regularly collected</li> <li>- Monitoring, Evaluation, and Learning (MEL) systems are in place in all relevant water sector entities. Relevant data analysis capacity is institutionalized within each water institution, fully integrated to data collection systems</li> </ul>	Ongoing development, MEL systems by 2024
<b>Objective 3.3:</b> Regular coordination across government to align sector planning and water budgets to national strategic priorities, such as Ministry of Finance, Ministry of Agriculture, Ministry of Energy, Ministry of Environment, Ministry of Planning and International Cooperation, municipalities, and Ministry of Health	Active formal platforms for coordination and consultation on water sector policy in place and regularly utilized	Immediate
<b>Objective 3.4:</b> Maintain updated capital investment planning for sector infrastructure needs and critical systems investments	Capital Investment Plans (CIP) are current and linked directly to sector master plans. CIPs are updated quarterly. CIPs provided on demand to donors.	By 2023 From 2024 From 2024
<b>Objective 3.5:</b> Ensure effective donor coordination to leverage the support of international partners, match donor funding to critical sector needs, and avoid duplication	<ul style="list-style-type: none"> <li>- Coordination of projects with donor agencies is consolidated</li> <li>- Developed and updated systems track all donor-funded activities, CIP, and generate regular pipeline for donor support</li> </ul>	From 2024 From 2025

## Strategic Approach

This goal requires a sector-wide commitment to effective implementation. It is too easy to have policies and strategies developed and left unimplemented. The key is to follow planning implementation, decision making and continuous updating within executive plans that are institutionalized into day-to-day operations and management procedures. Figure 43 below presents the implementation, oversight, and adaptation cycle for strategy implementation.



**Figure 43: National Water Strategy Implementation, Monitoring, and Reporting Cycle**

**Strategy Implementation Framework (SIF).** Develop a unified roadmap for the water sector through translating this strategy into achievable and measurable results, with preidentified performance indicators, time-bound targets, and responsibilities. The water sector must work on developing its institutions' annual plans are derived from the SIF and are structured toward the achievement of the overall pillar and strategic goals and objectives.

**Institutionalize Monitoring and Evaluation against annual plans and budgets.** Formulate a Monitoring, Evaluation, and Learning (MEL) Framework, and activate the MEL functions through a MEL Action Plan with clear data flow channels and responsibilities along with reporting mechanisms. Ensure that effective and continuous learning from the MEL findings is in place through highlighting and building on success, while identifying gaps and converting them into future opportunities in project planning and funding allocations. Communicate findings and recommendations with the donor community, private sector, and other major stakeholders and establish initiatives and future partnerships.

**Maintain updated Capital Investment Planning.** WAJ, JVA, and MWI need to consolidate and then institutionalize a mechanism for joint capital investment planning and annual updating of a sector-wide Capital Investment Plan (CIP). With a regularly updated plan, the CIP becomes the basis for coordinating donor and national budget infrastructure investments. It further facilitates the ability to prioritize investments as they can be assessed against overall sector and national priorities, reflecting ongoing investments and donor commitment.

**Donor coordination.** Donor support is a vital resource for the sector, enabling significantly higher levels of infrastructure and institutional development than would be possible if fully self-financed. Therefore, the sector must work on institutionalizing and consolidating it, through MWI's continuous communication with the donor community and existing support to include a document and systems review and stakeholder consultations to better define donor coordination and project tracking needs, and updating and linking the donor coordination information system to new donor coordination procedures that are evidence-based and aligned to master plans and the NWS.

## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
MWI	- Develop and operationalization of Strategy Implementation Framework (SIF)
WAJ	- Improved data collection, sharing, analysis, and reporting
JVA	- Joint capital investment planning
	- Integrated donor coordination reporting and planning
MWI	- Update donor coordination information system and procedures

	<ul style="list-style-type: none"> <li>- Consolidate and follow up the capital investment planning</li> <li>- Update and upgrade the National Water Information System (NWIS)</li> </ul>
Utilities	<ul style="list-style-type: none"> <li>- Link business plans, annual plans, and budgets to SIF</li> </ul>
Regulator	<ul style="list-style-type: none"> <li>- Link water services MEL framework to national policy MEL mechanism</li> </ul>
MoPIC	<ul style="list-style-type: none"> <li>- Ensure sector's plans and donors support are in line with the national plans, targets, and priorities</li> </ul>
Donors	<ul style="list-style-type: none"> <li>- Cooperate across donors to enable effective donor coordination</li> <li>- Prioritize support against CIP and national strategies and plans</li> </ul>

### Human and Financial Resources and Requirements

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- SIF development taskforces created</li> <li>- Capacity development in planning and MEL</li> <li>- Information technology (IT) systems development and operations capacity</li> </ul>	<ul style="list-style-type: none"> <li>- Annual budget allocations for IT systems maintenance and upgrades, as needed</li> </ul>	<ul style="list-style-type: none"> <li>- Leadership commitment and mandates for new approaches</li> <li>- Change management and process reengineering to facilitate integration of continuous planning, management, monitoring and evaluation</li> </ul>

## Goal 4: Promote Gender, Inclusion, and Youth Empowerment throughout the Water Sector

Jordan is committed to supporting the efforts accomplished under the Global Sustainable Development Goals (SDGs), including the efforts achieved under SDGs 5 which calls for achieving gender equality and empower all women. Therefore, the water sector takes into account in the recruitment processes attracting female competencies and giving them a stronger role in various fields, where women in Jordan comprise over half of the universities graduates, and their participation rate in labor force was only 14% in 2021 (Department of Statistics).

To enhance women's participation in the water sector for the coming 20 years, Goal 4 will focus on provision of sector plans, policies, and tools that would; 1) encourage women and freshly graduated youth to enter the water sector, and 2) promote gender mainstreaming and women empowerment for leadership positions in the water sector. This section describes the gender inclusion objectives that also target inclusion of youth and PWD's, indicators, timeline, and the strategic approach to implement and assess the efforts under this Goal.

### Objectives

Goal 4: Promote gender, inclusion, and youth empowerment throughout the water sector		
Indicator/Target: Growing numbers of women in leadership roles, youth hires, and representation across all segments of Jordanian society in sector employment		
Objectives	Indicators/Target	Timeline
<b>Objective 4.1:</b> Strengthen gender mainstreaming in sector plans, strategies, programs, outreach, engagement, and activities.	<ul style="list-style-type: none"> <li>- All sector strategies, master plans, business plans, and action plans explicitly address gender considerations and gender equity.</li> <li>- Sector performance monitoring and evaluation systems and reporting disaggregated by gender to track progress, promote learning, and identify areas for improvement.</li> <li>- Annual report on gender and inclusion published publicly.</li> </ul>	From 2024
<b>Objective 4.2:</b> Increase women's participation at all levels of the water sector, with specific	<ul style="list-style-type: none"> <li>- Increase women's participation in leadership roles by 25% by 2030 and 30% occupation of management/leadership roles held by women by 2040.</li> </ul>	Ongoing

representation in decision-making and leadership positions	- Equitable representation of women on utility Boards of Directors.	
<b>Objective 4.3</b> : Increase youth engagement and hiring within the sector to develop the next generation of water sector leaders and operators.	<ul style="list-style-type: none"> <li>- Youth groups engaged in public participation for sector planning and increase their employment.</li> <li>- Professional development and training opportunities provided to high-performing early career staff.</li> <li>- Linkages with research centers and universities that provide opportunities for youth to be more engaged in research, cutting edge technologies and innovation.</li> </ul>	Ongoing
<b>Objective 3.54.4:</b> Persons with disabilities engaged in the water sector at all levels, and employment increased	<ul style="list-style-type: none"> <li>- Persons with disabilities engaged in public participation for sector planning and execution.</li> <li>- Persons with disabilities employed and integrated as possible</li> </ul>	2040

## Strategic Approach

Achieving gender mainstreaming integration at all levels, starting with the sector strategies and plans, as well as the policies and procedures to ensure equity for women's role in the water sector, a special focus needs to be placed on increasing women's representation in decision-making and leadership. The sector should work on equally attracting qualified men and women to vacant positions, and current female staff are equally offered technical and leadership skills training opportunities that would build a career path for women toward leadership.

Implementation of the current Gender Policy for the Water Sector, adopted in 2020, must continue. Activities of strategic planning, institutional development, HR, and financial management are required to include budgeting and programming for gender, inclusion, and youth engagement activities along with efforts to increase PWD hiring and professional development. Effectiveness of the sector in improving equity and inclusion will be tracked through the gender disaggregation and inclusion metrics in data collection tools and human resources data and records. The sector will also rigorously enforce a zero-tolerance policy toward all forms of harassment or violence at work, including verbal or physical abuse and sexual harassment.

The water sector entities will also work on including in contracts' provisions of its consultants and contractors to enforce gender equity, and even to define certain participation percentages of women in the work force for each contract.

## Institutional Roles and Responsibilities, Resources, and Requirements

The MWI restructured the Gender Unit in 2018 with a clear scope of work and released the Gender Policy for the Water Sector in 2020. The Gender Policy draws the road map for gender mainstreaming in the water sector, and provides clear goals, objectives, and key performance indicators to achieve it in general.

Institution	Key Institutional Roles
MWI Gender Unit	<ul style="list-style-type: none"> <li>- Implementation of Gender Policy for the Water Sector</li> <li>- Convene Gender Focal Points Network</li> <li>- Work with gender focal points to mainstream gender and Gender Policy Action Plans</li> <li>- Regularly review and update, as needed, gender equality and social inclusion (GESI) KPIs</li> <li>- Develop and provide training on gender mainstreaming and tools</li> </ul>
Water entities	<ul style="list-style-type: none"> <li>- Establish a Gender Focal Point</li> <li>- Support the Gender Focal Point's Network</li> <li>- Monitor consultants and contractors' commitment to include women in their work force</li> <li>- Collect and report on GESI KPIs</li> </ul>

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"><li>- Gender Focal Points</li><li>- Training staff</li><li>- Empower the Gender Unit through proper training</li></ul>	<ul style="list-style-type: none"><li>- Budget allocations for training and gender mainstreaming</li></ul>	<ul style="list-style-type: none"><li>- Leadership commitment and support for GESI principles and priorities</li></ul>

## Monitoring and Evaluation

There is a crucial need to adopt a monitoring and evaluation mechanism for the NWS, and to institutionalize MEL against sector master plans and SIF. Data collection must be timely and reliable with regular reporting of findings and results that are easily and publicly accessible. In addition, a data quality assurance mechanism will be introduced, collection procedures reviewed, and sharing of information assured. With the advent of the Sustainable Development Goals (2015-2030) and the greater emphasis on country reporting, performance indicators will be linked with the global indicators. The NWS will be reviewed, with targets and indicators updated, at a minimum of every five years.

## Conclusion

Effective sector governance is a fundamental prerequisite to sustainable its management and lasting water security. However, there has not yet been enough attention paid to governance as the priority has always been on operations and services. This strategy reflects the understanding and reality that it is very hard to improve operations and services without there being a sound foundation of effective, accountable, and transparent sector governance. These will not be easy goals to achieve. Overall sector restructuring will be required along with a transformation within water entities in terms of how they manage the sector, as well as their staff, systems, and resources. In addition, achieving these goals is also a responsibility shared by the institutions of the Government of Jordan as a whole. The national government needs to become a supporter and advocate for the institutional restructuring, regulation, and management and legal changes needed.

Good governance alone cannot provide absolute assurance that objectives will be met, but it provides reasonable opportunity and the tools and approaches needed for leadership, managers, and sector staff to better fulfill their mandates and carry out their roles and responsibilities. This is vital.

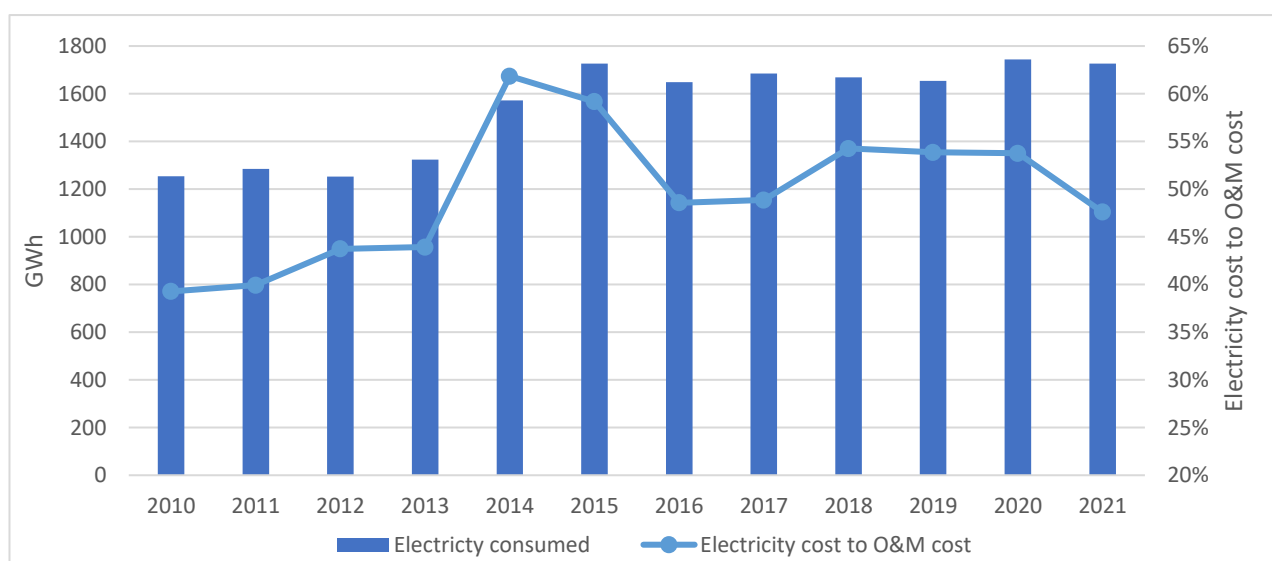
Water affects everyone in the country and must be governed and managed with the level of care, capacity, and investment required to do that effectively. This also further emphasizes why the sector itself needs to reflect society in its staffing, planning, and policies. The representation of women, youth, and PWDs in sector staffing must be tackled. Sector facilities and jobs need to become more accessible to PWDs and equity must remain a core commitment for the sector.

## 9 ENERGY EFFICIENCY AND RENEWABLE ENERGY IN THE WATER SECTOR

Energy accounts for around half the operational budget of WAJ and water companies, and 20% of the operational budget of JVA. The energy consumption required for the expansion in producing additional water supply sources continue to grow, like seawater desalination and deep aquifers which have become the remaining new sources, and both consume energy higher than the need of one cubic meter from the current conventional resources. Additionally, these new resources are at farther away locations from demand centers, which significantly increases the need for operational energy. Therefore, it became imperative for the water sector to maximize energy efficiency at every stage from production to delivery at subscribers' meters. The fact that tariffs remain well below cost recovery levels only further enforces the need for lowering energy cost on the sector, implementing investments in renewable energy, and finding operational solutions that lead to cost reduction, sustainability enforcement and services enhancement, due to its vital role in the long-term water security and financial sustainability.

### Current Situation

The water sector in Jordan consumes substantial amounts of energy to produce and deliver potable water to consumers all over the country. This is due to the use of groundwater, the natural topography through which water pipelines pass for water delivery to demand centers, and geological features of the water bearing strata. Natural fresh surface water sources are very limited and among the available ground water is the deep one, and continuously diminishing with over abstraction. Water pumping is required against a head of 1,400 m for some places which results in high energy consumption. Even seawater desalination requires pumping treated water for hundreds of kilometers as Aqaba is Jordan's only access to the sea, but water is needed in Amman and other middle and northern cities. The high energy consumption has also intensified because of the increase in water demand and searching for new resources due to an unprecedented growth in population resulting from the influx of refugees from neighboring countries. Figure 44 shows percentage of energy cost to the total O&M cost, which has increased from less than 50% in 2010 to more than 50% during the recent years. The Figure also shows the progressive increase in energy use for water and wastewater services over 2010-2021, which increased by 38%.



**Figure 44: Electricity Use and Its Cost Ratio to O&M Cost over 2010-2021**

Country wide energy consumption by the water sector was reported in 2021 to be around 3.3 kWh/m<sup>3</sup> (MWI, 2021). This is quite high compared with average values in the USA and Germany, for example, where energy



consumption is 0.42 kWh/m<sup>3</sup> for surface water, 0.55 kWh/m<sup>3</sup> for groundwater, and about 3.17 kWh/m<sup>3</sup> for desalinated water (Voltz, T. and Grischek, 2018).

On the other hand, the issue of energy efficiency of the water pumps still needs more work, as their efficiency is still low in some cases due to the lack of analysis and evaluation of yield power consumption, incorrect operating practices, and poor preventive maintenance. As high as it is now, unfortunately, the energy intensity of water sector operations in Jordan is poised to become even higher and more challenging in the future due to the following factors:

- deteriorating water quality of available resources requiring further treatment operations
- groundwater current over-abstraction leading to searching for deeper resources, and
- inevitable need for desalinating water and conveying it to demand centers

Therefore, sustainable and long-lasting changes in energy utilization in the water sector have become a national priority. All public and private sector entities must work hand in hand to achieve this objective as water is clearly the backbone to national health and sectoral development. To achieve the desired changes, two national strategy goals have been developed with corresponding objectives that are measurable and time bound against a combination of quantitative and qualitative indicators.

## Key Challenges, Considerations, Opportunities, and Threats

The following key challenges have impeded energy efficiency efforts and implementation of new sector goals:

**Limited national-level planning to shift to renewable energy in Jordan over the coming ten years.** In 2021, the energy mix in Jordan<sup>51</sup> remained overwhelmingly oil and natural gas, with renewable energy supplies contributing about 14%. While, the plan calls for modest shifts to increase natural gas to 25% and keep the same share of renewable energy at 14% and reducing oil to 51%. This means that most sectors in Jordan will not be able to increase their share of renewable energy significantly and that sectors will all compete for this small additional increase.

**Limited data availability and accuracy.** As the water sector has tried to better understand, manage, and plan for energy-related improvements, it faced significant challenges in relation to the collection of energy and associated data. This includes insufficiency of data related to energy consumption and quantities of water pumped. Although a lack of data should not prevent identification and implementation of energy saving opportunities, it does, however, make it difficult to develop effective energy performance indicators for the water sector that allow to study the feasibility of projects and investment in its cost saving. The sector will aim at availing a national database that compiles digital data for energy consumption and for relevant variables affecting energy consumption.

**Roles and responsibilities not clearly defined.** Although the water sector, including MWI, WAJ, and utilities agree on the importance of energy efficiency and renewable energy, there seems to be a need for identifying roles and responsibilities. Energy management in a sector as complex as the water sector requires a systematic and integrated approach with clear identification of who is responsible for what. Items that should be well defined include alignment of energy objectives at all levels, proper planning to identify available energy saving opportunities in a systematic manner, connecting planning outcomes with operational tasks, in addition to training to continuously build on practical examples and demonstrations.

**Resource allocations.** In some instances, there are no budget lines allocated at financial budgets of water institutions that are related to energy saving opportunities. Therefore, the sector needs to work on availing sufficient financial resources in order to implement renewable energy projects and energy efficiency.

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<sup>51</sup> MEMR, Jordan National Energy Strategy, 2020 and Energy Balance Data of 2021

# Goal 1: Improve Energy Efficiency in All Water Sector Operations through Better Energy Management Practices in Order to Lower Costs and Improve Financial Performance of the Sector

## Objectives

To achieve the goal of improved energy efficiency, the sector commits to implementing three main objectives that target a range of pathways to improve energy efficiency in water supply operations, particularly in production, transmission, treatment, and recycling. MWI has a strategic objective of reducing total energy consumption by 15% by 2025 from 2019 figures, estimated and set at 6.6 kWh/m<sup>3</sup> billed and 3.4 kWh/m<sup>3</sup> supplied, provided that the achievement in relation to this goal is evaluated in the year 2025, and then new goals are set, taking the 2025 data as the baseline. Since the achievement of this goal will be monitored from 2022 to 2025, setting new goals until 2040 will depend on actual statistics. It is expected that sufficient data will be available by 2025 to set a realistic and applicable target based on accurate information. A standard model will be employed to accurately represent the relationship between variables and energy consumption, considering current plans and projects and all achievements to date in the energy management system.

Goal 1: Improve energy efficiency in all water sector operations through better energy management practices in order to lower costs and improve financial performance of the sector				
Indicator/Target: Energy used for each m <sup>3</sup> of water produced, distributed, and treated is steadily reduced				
Objectives	Indicators	Baseline (2019)	Target	Timeline
<b>Objective 1.1:</b> Improve energy efficiency in bulk water production and transmission and supply (WAJ/JVA) through optimized operations	kWh/m <sup>3</sup> of water produced	3.4 kWh/m <sup>3</sup>	2.9 kWh/m <sup>3</sup>	2025
<b>Objective 1.2:</b> Improve energy efficiency of water supply, treatment, and distribution through optimized network operations	kWh/m <sup>3</sup> of water distributed by each utility	NA	TBD	From 2025
<b>Objective 1.3:</b> Improve energy efficiency in wastewater treatment and transmission of treated effluent	kWh/m <sup>3</sup> of wastewater treated	NA	TBD	From 2025
<b>Objective 1.4:</b> Implement energy management systems to gradually cover the entire water sector	Implement Energy Management System (EnMS) for all energy-using water sector facilities. <ul style="list-style-type: none"> <li>EnMS covering 60% of water sector by 2025</li> <li>EnMS with 100% coverage by 2030 measured by kWh consumed by water sector activities</li> </ul>			2030

**Objective 1.4: Implement energy management systems to gradually cover the entire water sector.** The goal of implementing an Energy Management System (EnMS) is to ensure the incorporation of energy efficiency into existing practices and processes within water utilities and focus on continual improvement of energy performance and reduction in operational cost. This is achieved by developing the technical and organizational capacities of water providers and anchoring and applying central elements of the EnMS, in accordance with the ISO 50001 framework: Plan-Do-Check-Act (PDCA) for continual improvement.

The EnMS will ensure energy use efficiency is considered in the design and operation of water facilities and that the water sector works together to achieve its energy targets and strategy. Action plans will be monitored to ensure that the water sector is working to reach its specific energy-related targets. The EnMS will also focus on increasing data reliability and utilization to help the water sector in taking better decisions at the technical and managerial level.

The EnMS is being developed in two phases - a pilot scale phase and a full-scale implementation phase to follow. The pilot phase is already completed and includes specific water assets within water companies in addition to JVA. Full scale implementation shall be developed gradually to include the complete water sector by 2030.

## Goal 2: Expand the Use of Renewable Energy across Water Sector Operations to Lower Costs and Improve Financial Performance of the Sector

### Objectives

**Objective 2.1. Cooperate closely with the Ministry of Energy and relevant ministries to strengthen the enabling environment for the use of renewable energy in water sector operations.** The water sector cannot achieve its own energy efficiency and renewable energy targets without the cooperation and support of an effective enabling environment from the energy sector. For example, currently, the MEMR does not allow renewable energy projects to generate more than 1 MW without the express approval of the Cabinet. In addition, energy policy and regulatory measures will need to be updated or established to facilitate the specific use of renewable energy in the water sector. This will require close collaboration to align energy sector policy items that directly affect the sector. Ideally, jointly preparing a master plan for the sector's energy needs at respective locations would be the starting point for collaboration and cooperation, particularly when the water sector plan in energy is superimposed on a similar plan of the energy sector showing the location and amount of energy available. This is already necessary for the treatment plant and along the route of the National Conveyance Project, where green energy is a serious component.

**Objective 2.2: Develop renewable energy projects in collaboration with the Ministry of Energy and Mineral Resources.** Despite the current limitation on renewable energy projects, the MWI will pursue developing a mix of large (> 1 MW) and small (< 1 MW) renewable energy projects given the urgent need to reduce the financial burden of water sector operations. The overall aim is to produce 40% of sector energy needs from renewable energy by 2040, considering a baseline consumption of 1,654 GWh from 2019. This is planned around development of projects with a total capacity of 140 MW of renewable energy between 2020 to 2030 and an additional similar quantity for 2030 to 2040. The most applicable and economical renewable power sources in Jordan seem to be photovoltaics (PV) and wind farms. Net-metering, wheeling, and direct proposals mechanisms will be applied in collaboration with MEMR and in partnership with the private sector were possible to achieve this objective.

Goal 2: Expand the use of renewable energy across water sector operations to lower costs and improve financial performance of the sector		
Indicator/Target: Energy supplied to water sector operations from renewable energy sources reaches 40% by 2040		
Objectives	Indicators/Target	Timeline
<b>Objective 2.1:</b> Cooperate closely with the MEMR and relevant ministries to strengthen the enabling environment for the use of renewable energy in water sector operations	Collaborate to develop a range of policy and regulatory measures to facilitate the use of renewable energy in the water sector and close collaboration on energy sector policy that directly affects the water sector	Ongoing
<b>Objective 2.2:</b> Develop large (> 1 MW) and small-scale (< 1 MW) renewable energy projects in collaboration with MEMR	Proportion of renewable energy reaches 40% of overall energy use in water operations	2040

## Strategic Approach

To implement the goals and objectives, some implementation strategies and actions are proposed based on a bottom-up approach that links strategic objectives of the ministry to practical conditions on the ground. These proposed actions intend to introduce the required positive change in a manner that is suitable to the current situation of the utilities, WAJ, and JVA. The proposed implementation strategies were obtained from lessons learned during the implementation of the pilot scale EnMS within each of the water institutions.

### Leadership and Commitment

The positive, long-lasting change in the water sector, requires top management and commitment of MWI, WAJ, JVA, and all utilities to implement these goals and objectives, whereby top utility management ensures the integration of the strategy into day-to-day operational procedures and that appropriate and adequate resources are allocated. It is also necessary that each water company develop a brief energy efficiency and renewable energy framework document, consisting of a declaration of commitment, specific departments responsible for implementation, and DMS and EnMS development plan.

### Empower Energy Units in WAJ, Utility Companies, and JVA

Since energy efficiency and renewable energy projects require consistent long-term planning, implementation, checking, and adjusting, it is recommended to support and empower energy efficiency units in each of the utilities and WAJ, and establish a similar unit at JVA. Each energy efficiency unit should become the source of information and support for the entire company to implement the energy strategy and energy management action plan.

### Institutional Development

To socialize and enable implementation of these goals and objectives, an awareness campaign should be organized to ensure every staff member within the water sector is aware of the strategy goals, objectives, and indicators for energy. In addition, a training needs assessment should be completed to assess the training needs to reach a suitable competency level among staff with a key role in advancing the strategy's objectives. The results of the training needs assessment should be adopted and integrated into the training plans for each water sector institution.

## Institutional Roles, Responsibilities, and Requirements

Overall responsibility for strategy implementation lies with sector leadership, however, none of the goals can be achieved without action and commitment throughout each responsible institution. It is essential that staff members involved in the implementation are aware of their roles and are professionally trained to be able to fulfill them. WAJ, JVA and water companies are responsible for establishing or empowering energy efficiency units within their organizations as well as ensuring funds for capital investments and planning for energy efficiency and renewable energy are fully incorporated into the sector capital investment plan. Several ministries need to be engaged to encourage private sector participation and an effective legal framework that regulates private sector participation. Specific roles, responsibilities, and resources are outlined below.

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
MWI	<ul style="list-style-type: none"><li>- Establish the strategy and supporting regulations</li><li>- Empower and sufficiently staff institutional capacity for Nexus</li><li>- Coordinate the cooperation with MEMR</li></ul>
WAJ/JVA	<ul style="list-style-type: none"><li>- Empower and sufficiently staff Energy Units</li><li>- Coordinate / support the implementation of EnMS in the water sector</li><li>- Implement RE projects</li></ul>

Water Companies	<ul style="list-style-type: none"> <li>- Empower and sufficiently staff an Energy Unit</li> <li>- Implement Energy Management System (EnMS)</li> <li>- Implement energy saving opportunities</li> <li>- Develop decentralized small RE systems</li> </ul>
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### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- Support to the staff of energy units at MWI, WAJ, JVA and at water utilities</li> <li>- Seek Technical assistance where needed</li> </ul>	<ul style="list-style-type: none"> <li>- WAJ and JVA to supply major investments</li> <li>- Water utilities to provide minor investments</li> <li>- Private sector investments</li> <li>- Donor agencies' funds</li> </ul>	<ul style="list-style-type: none"> <li>- Data and information analytics system to support details targeting potential areas for energy reduction</li> <li>- Support from Government for the water sector to seek renewable energy sources</li> </ul>

## Monitoring and Evaluation

The Energy Efficiency Units in all water sector entities will work on monitoring the progress of achieving the action plans developed for improving energy use and ensure that other operational units are working effectively on their related roles. At the national level, the UPMU (or the future regulator) will monitor the water companies' progress in achieving this both goals.

## Conclusion

The need to reduce energy consumption through efficiency measures and increasing the share of renewable energy in the water sector are essential for the sector to achieve the development of an Energy Management System at all sector facilities is underway and needs to be scaled throughout the sector. Strategic targets for overall energy consumption will be developed in 2025 based on reliable figures generated from the updated data gathering and analysis. The sector will also coordinate with MEMR to amend rules and regulations to be tailored specifically for water sector needs for power and a joint and harmonized planning between water and energy sectors should be enhanced.

## 10 INNOVATION, TECHNOLOGY, AND PRIVATE SECTOR ENGAGEMENT

The scope and scale of the challenges facing Jordan to achieve the pillar goals and provide sustainable and durable water security for the country's health, prosperity, and development will require constant adaptation and capitalizing on new tools and approaches wherever needed. This strategy sets out how the water sector must leverage innovation and technological advances where they are suited to Jordan's water and sanitation infrastructure and management needs. The private sector needs to become a strong partner in service delivery improvements, water supply development, recycled water use, and improved efficiencies in agricultural and industrial water use. Each of these elements plays a vital role in supporting the NWS Goals, the Jordan Economic Reform Vision, and SDG goals more broadly.

### Current Situation

While water entities and utilities have multiple management information systems, they remain in need for interconnection, integration and streamlining of information for decision makers. Despite the water sector relative success in incorporating advanced technologies and infrastructure systems to support certain operational and administrative areas across the water institutions, the weak linkages cause fragmentation of data and information. Retrieving and collecting information across these different entities is cumbersome and time consuming. There is a lack of advanced data collection and consolidation mechanisms, and archiving systems that would provide a technological institutional memory. Responsibilities for collecting, archiving, updating, and providing data in a regular, participatory, and transparent way need to be improved. Data analysis is still incompetent, thus hindering the issuance of yearly reports and some intermittent or statistical bulletins.

As for the technology domain, some of the water utilities use system technologies different from those at MWI and WAJ. This is not an insurmountable barrier but places a strong burden on ensuring consistent collection and sharing of quality data from each system. This can then enable timely analysis and data sharing with decision makers. The sector has also struggled with either not fully implementing technology solutions or failing to sustain systems utilization upon adoption. Numerous technology-related projects are initially funded, managed, and implemented by donors, but are often not sustained after donor support ends.

Digital transformation, on the other hand, plays a role in enhancing transparency, reducing bureaucracy and corruption, expanding operations, and accessing a larger segment of beneficiaries. For the water sector, the global scene is witnessing a compelling digital transformation coined Digital Water or Internet of Water. Global water utilities are deploying innovative solutions for major challenges such as conservation and water supply. Digital technologies offer the potential to help water entities and utilities become resilient and efficient. However, the cost of adopting technology is sometimes deterring water entities and utilities from embracing innovative solutions. Often, introducing technology is considered as a cost rather than an investment. With limited budgets, it can be a very difficult tradeoff to decide whether to use part of the budget for day-to-day operations or to deploy a digital solution that can drive long-term efficiencies. One of the key challenges is to attract and retain qualified IT staff, where many persons leave for better opportunities in the private sector, particularly in specialized job categories after getting more competent.

On the other hand, the water sector has experience in private sector engagement areas, such as partial outsourcing of operations, management contracts, Build Operate Transfer (BOT)s and leasing. The water sector could benefit from the private sector's experiences to identify innovative solutions, engage to build technical knowledge and institutional capacity, and invest in promising areas within the sector that can benefit from private sector management and accountability approaches.



## Key Challenges, Considerations, and Opportunities

**Availability of necessary data for decision-making.** Data in the water sector is both structured and unstructured originating from disparate sources. The ability to collect and have access to quality data characterized by validity, integrity, precision, reliability, and timeliness, is simply not there. Sector personnel, let alone decision makers, are unable to effectively or quickly access relevant information needed to support policies, regulation, performance management, or planning. Often, data types are frequently misinterpreted for lack of proper classification and standardization. The water sector entities' responsibilities are complex and with numerous data silos. The growing challenge lies in systems integration and interoperability. Though solutions to achieve integration among water sector systems are there, open architecture and standardization hold the potential to accelerate the adoption of digital solutions. Decision makers need to determine their exact KPIs and reporting requirements across all management areas (water situation, capital investment, project management, finance, etc.) to be regularly collected and consolidated.

**Different technology systems do not provide standardized data and information.** The water sector is aware of the magnitude of changes accompanying the digital transformation process. However, for technology and innovation, there is no single strategy, policy, or masterplan framework developed and enforced in the water sector that defines the requirements for coping with digital transformation. As a result, there is no guidance to institutionalize knowledge sharing and technology adoption across the sector. Each of the water sector entities develops its technologies in silos, potentially losing opportunities to yield results more aligned with the sector's needs at large. The sector needs digital transformation to improve performance and should invest in consultations and research into viable new technologies and pilot projects. The sector needs to plan technological investments to support both short- and long-term needs and align with business management needs.

**Digital transformation and technology investment versus cost.** When implemented effectively, digital transformation lowers operational expenditure, increases workforce efficiencies, and increases customer satisfaction, allowing exploitation of the value of data, automation, and artificial intelligence and the water utilities to extend water resources, reduce NRW, optimize infrastructure life cycles, and strengthen financial sustainability. It is critical that the sector prioritizes digital transformation investment, training, and process reengineering. Adopted technologies should meet internationally accepted standards and focus on the benefits identified in the business case they were brought to tackle. Digital transformation is increasingly triggered by customers who expect digital solutions. Moreover, the sector's growing demand on its services is mandating innovative and feasible technological solutions, which have become more vital within Jordan's water scarcity crisis.

**Staff adaptation to technology.** The success of digital solutions is often not a function of technology, but rather of the people and the processes that leverage these solutions. Many digital transformation programs fail due to employees' resistance. Without their acceptance, digital programs will take more time, resources, and cost. In many instances, end-users do not utilize available technological systems for the lack of functional competencies in dealing with rapidly developing modern technology or for mere resistance to change. Training and related documentation will facilitate ownership of these systems. Capacity building and outreach will help employees overcome the fear of handling data and resulting in transparency. They will build willingness to explore digital technologies in addition to improving the employees' efficiency and productivity.

**Collaboration with academia.** There is a need for utilizing Jordan's research institutes and universities as a partner to the water sector. There are currently no platforms that institutionalize collaboration and learning between these academic institutions and the water sector. Academia also has the advantage in that it has access to the youth and the capability to unleash their creativity and innovation. Therefore, the sector needs to create frameworks through which increased collaboration is secured, to facilitate the introduction, testing, and adoption of novel research methods and technologies.



**Cost of technology.** Digital solutions need to be framed in the context of their value proposition within the institutions as well as the sector. Demonstrating case studies and business models will help decision makers readily embrace technologies and allocate the required financial budgets.

**Coordination with other government entities.** Government of Jordan digital transformation efforts are being led by the Ministry of Digital Economy and Entrepreneurship (MODEE). The water sector needs to strengthen cooperation and collaboration to leverage these ongoing efforts and align water sector transformation with GoJ initiatives. For example, this could involve consolidating software licenses and ensuring that equipment procurement is compliant with evolving digital laws and regulations.

**Private Sector Engagement.** The water sector relies on the private sector in various areas, as it provides the advanced technology used within the sector, and is a key partner in large-scale national infrastructure BOT projects that require large capital investment, sophisticated technology, advanced management practices, and smart financing, as in the case for the National Conveyance Project transporting desalinated water from Aqaba to Amman. The gaps in the regulatory and financial management of the sector represent risks for the private sector, and the sector needs to mitigate them in order to enhance its attractiveness and ability in managing Public-Private Partnership (PPP) and to carry out the necessary public awareness campaigns.

## Goal 1: Utilize Technology across the Sector to Improve the Accuracy and Timeliness of Data Collection, Strengthen Data Analysis, and Streamline Management Systems

Data is at the heart of an effective and accountable water sector. Technology can greatly strengthen the collection, analysis, and utilization of data, which offers a significant opportunity for the water sector to overcome persistent challenges in this area as this need has never been greater.

### Objectives

Goal 1: Utilize technology across the sector to improve the accuracy and timeliness of data collection, strengthen data analysis, and streamline management systems		
Indicator/Target: Compatible systems deployed across utility companies and water authorities with full integration of technology into day-to-day sector operations and management		
Objectives	Indicators/Target	Timeline
<b>Objective 1.1:</b> Maximize digital transformation and business processes automation for improved efficiencies and effectiveness within utility companies and water sector institutions	Fully operationalize ERP-based management systems within all utility companies. Automate business processes within government water entities wherever practical and appropriate as suitable technologies and systems are developed and affordable.	2026
<b>Objective 1.2:</b> Integrate and standardize data collection and management systems across the water sector entities	Data is easily shared, on demand, between water sector entities, the regulator, and government authorities	From 2025
<b>Objective 1.3:</b> Ensure sector planning, policy making, and regulatory reviews are based on accurate, reliable, and timely data	Management information systems feed directly into planning processes and regulation-related data is provided on time and with a high degree of accuracy	Ongoing
<b>Objective 1.4:</b> Maximize the use of technology to improve groundwater and surface water data availability and quality	Expanded use of technological alternatives for reliable metering or abstraction quantities for all bulk water production and groundwater abstraction, as appropriate	Ongoing
<b>Objective 1.5:</b> Complete the development of the National Water Information System (NWIS) that is internally inclusive and integrated with related entities outside the water sector	Developed NWIS that is comprehensive and integrated with other systems in other entities outside the water sector including MoA, MoEnv, MoH, Jordan Metrological Department (JMD), DOS, Royal Scientific Society (RSS), and Royal Jordanian Geographical Center (RJGC) to	2026

	facilitate monitoring the SDG's targets and decision-making process	
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## Strategic Approach

**Enhance water sector systems and structures to generate high data quality.** MWI will lead the process of institutionalizing and building an automated reporting and analytical water information system to ensure a shared platform for centralized information that can be accessible by decision makers. This will include classifying data with standardized definitions and requirements to improve quality. Existing water sector information systems will be updated or integrated to allow data to be combined across each water sector entity from multiple systems, such as: customer information systems (CIS), billing functions, geographic information systems (GIS), supply chain, SCADA, metering, and other subsystems.

**Build internal capacity to improve skill sets in data utilization and technology and generate acceptance.** Technology and systems strengthening to improve data collection requires well trained system users and working closely with decision makers to meet their requirements in decision making and strengthen the reliability of this data and information. It is also essential to institutionalize the flow of this data through these systems and their analysis to become routine in each entity. This requires the involvement and support of sector leaders in this process, explaining the benefits of using technology, and providing a stimulating environment for that.

**Ensure and enforce sector-wide compliance with internationally accepted best practices in information technology.** The water institutions need to start first with updating strategies and policies to integrate and clarify digital transformation standards. To then create a climate that promotes digital transformation, each entity needs to establish incentive programs to promote innovation and may outsource some capacity building and solution development to the private sector. An Information Communication Technology (ICT) committee of water entities and utilities is needed to strengthen coordination among them and facilitate uniformity and capacity development around systems and technology platforms.

**Enhance collaboration and partnerships with the private sector and academia.** The water sector must continue to expand partnerships with the private sector to attract new technologies and expertise. In addition, collaboration with academia needs to be built and institutionalized across the country with a range of collaborative agreements and joint initiatives to harness the drive and energy within universities and research institutes that can be applied to the actual day-to-day challenges facing the sector.

**Ensure cybersecurity and customer data protection.** Maintain security of water sector data and information through constant adoption of technologies, protocols, and updates.

## Institutional Roles, Responsibilities, and Resources

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
MWI WAJ JVA	<ul style="list-style-type: none"> <li>- Identify data requirements for decision-making</li> <li>- Build quality control measures for data/information</li> <li>- Develop a digital transformation strategy or policy for the water sector</li> <li>- Develop the NWIS and integrate with other national systems</li> <li>- Promote and lead digital transformation within the water sector</li> <li>- Support capacity building to improve workforce technology skills</li> </ul>
Water companies	<ul style="list-style-type: none"> <li>- Facilitate data classification and information sharing</li> <li>- Integrate with MWI/WAJ systems</li> </ul>
Ministry of Digital Economy,	<ul style="list-style-type: none"> <li>- Enhance the IT sector enabling environment</li> <li>- Support data standardization and cyber security</li> </ul>

## Human and Financial Resources Requirements

Human Resources	Financial Resources	Requirements
- Capacity building programs to develop staff skills in utilizing technology	- Provision of dedicated budget allocations - Donor support, where possible, combined with capacity building	- Initiate a Plan or ICT

## Goal 2: Innovative and Efficient Technologies are Continuously Adopted

The scope and scale of Jordan's water scarcity and sector management challenges require a range of solutions, including the continuous examination and integration of innovation and technology wherever appropriate and provide sufficient return on investment.

### Objectives

Goal 2: Innovative and efficient technologies are continuously adopted		
Indicator/Target: New technologies adopted that achieve efficiencies in water use or management		
Objectives	Indicators/Target	Timeline
<b>Objective 2.1:</b> Leverage private sector investments to introduce and expand water technologies	Projects, pilot technological solutions, process improvements, or management systems are developed and/or adopted through private sector participation, contracting, or investment	Ongoing
<b>Objective 2.2:</b> Institute and develop collaboration with academia and research centers	Joint projects and regular exchanges between the water sector and academia and research institutions to test and scale the latest research, technologies, and models	From 2023
<b>Objective 2.3:</b> Institutionalized National Innovation Center with a strong charter and mandate to work effectively across WEFE sectors related innovations	National Innovation Center is established and functional effectively to support decision-making, utilizing existing facilities, manpower and technical solutions	2024

### Strategic Approach

**Introduce or expand use of appropriate and effective water technologies that lead to optimization of processes.** Technologies in water are ever evolving. The sector should institutionalize an entity that monitors global developments in processes, systems, and system components from both hardware and software aspects as well as from technical and administrative and financial approaches. This knowledge would facilitate leveraging of private sector investments to introduce and expand water technologies while validation of information is made through academia, as it is skilled in research, and the water sector provides the arena for applied research and the private sector is the source for investment in the products and pilots. This would keep the sector current in water-related innovation and technology, creating an opportunity for excellence and leadership not only locally but also on a regional scale.

**Collaborate closely with academia and research centers.** Institute and develop a collaboration program between the water sector (MWI, WAJ, JVA, water companies, and private sector), universities, and research centers is vital. The developed program should be built on the water sector priorities, especially those identified throughout the NWS. The program will help to adopt innovative technologies for improving water use efficiency and increasing the returns per cubic meter of water.

### Resources, Responsibilities, and Requirements

#### Institutional Roles and Responsibilities

Institutions	Key Institutional Roles
<b>MWI</b>	- Develop and implement a sector-wide digital transformation strategy/policy.

Institutions	Key Institutional Roles
WAJ JVA	<ul style="list-style-type: none"> <li>- Develop and implement a capacity building program to enhance data utilization and technology aptness.</li> <li>- Collaboration with private sector entities and academia.</li> <li>- Institutionalize an entity for monitoring global advancements in water-related matters</li> </ul>
Water Utilities	<ul style="list-style-type: none"> <li>- Contribute to MWI/WAJ sector-wide digital transformation strategy/policy</li> <li>- Contribute to a capacity building program to enhance data and technology utilization</li> </ul>
MEMR, MoA, MoEnv	<ul style="list-style-type: none"> <li>- Support establishing the National Innovation Center that servers the WEFE nexus research areas</li> </ul>
Universities, and research institutions	<ul style="list-style-type: none"> <li>- Collaborate and work with the water sector entities in designing their related research activities and disseminate its results</li> <li>- Attract funding for research activities</li> </ul>

### Human and Financial Resources and Requirements

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- Capacity building programs to develop staff's skills in utilizing data and technology</li> <li>- Capacity building in monitoring technological advances in water</li> </ul>	<ul style="list-style-type: none"> <li>- Budget allocations and seek donor assistance technically and financially</li> </ul>	<ul style="list-style-type: none"> <li>- Sector-wide digital transformation strategy/policy</li> <li>- An institutionalized entity monitoring global achievements in water issues</li> </ul>

## Goal 3: Private Sector Participation Increased to Improve Operational Efficiency and Sustainability, Introduce Innovation and Technology, Access Higher Flexibility in Execution, Improve Risk Management, and Access to Alternative Funding

Given that the private sector is leading the innovation and technology development and deployment and enjoying higher flexibility in execution and accessing alternative financing, the water sector, will partner with the private sector to harness its sources of finance and know-how.

### Objectives

Goal 3: Private sector participation increased to improve operational efficiency and sustainability, introduce innovation and technology, access higher flexibility in execution, improve risk management, and access to alternative funding		
Indicator/Target: Partnering with private sector is valued and well-regulated in delivering high quality water sector operations, water and wastewater services, and critical investments		
Objectives	Indicators/Target	Timeline
<b>Objective 3.1:</b> Leverage private sector efficiencies and increased accountability in operations and contracting to shift operations, as appropriate, to private sector providers	Develop a portfolio of private sector participation projects and contracts, including PPPs, and outsourcing of utility functions	Ongoing
<b>Objective 3.2:</b> Strengthen the enabling environment for private sector participation, including capacity to effectively and efficiently manage procurements, contracts, and projects implementation and in full transparency with the public	Relinquish some direct operational activities to the private sector, reform the procurement process, and invest in project and contracts management capacity with high levels of public acceptance.	Ongoing

### Strategic Approach

**Establish fully operational PPP Units.** PPP Units serve to institutionalize the specific skills needed to effectively manage contracts and engagement with the private sector and should be empowered to lead the planning and management of PSP projects. Each water sector entity should have the required institutional

capacity to develop and execute PPP projects. A centralized and strong PPP unit in MWI should be assembled to coordinate the scattered existing ones and provide advisory support to other PPP efforts to the water sector entities. At a minimum, this should include ongoing BOT projects that are already operating or under preparation, as well as outsourcing of activities at the utilities level. Some of these areas could include: 1) O&M contracts for WWTP; 2) renewable energy production and energy efficiency; 3) PSPs at the WUA level for bulk purchase and distribution of irrigation water; and 4) technological systems in operations and administration. PPP Units should also include capacity development programs around managing PSP projects.

**Promote Private Sector Participation (PSP).** Improve accountability framework in the water sector, strengthen PSP, and launch a nationwide campaign by publishing the proven successes as a model and example of the PSP benefits.

## Resources, Responsibilities, and Requirements

### *Institutional Roles and Responsibilities*

Institutions	Key Institutional Roles
MWI, WAJ, JVA	<ul style="list-style-type: none"> <li>- Establish operational PPP Units</li> <li>- Launch public awareness campaign to promote benefits of PSP</li> </ul>
Water companies	<ul style="list-style-type: none"> <li>- Build the institutional capacity to develop and manage PPP projects</li> </ul>

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- Avail staff for the units</li> </ul>	<ul style="list-style-type: none"> <li>- Budget allocation and seek donor assistance technically and financially</li> </ul>	<ul style="list-style-type: none"> <li>- PPP unit in place</li> </ul>

## Monitoring and Evaluation

Leadership at water entities and utilities with the support of their ICT directorates to report progress against Goal 1 and Goal 2 and follow up with other units, such as UPMU, on their related outcomes assigned to them toward achieving these goals. As for Goal 3, the PPP Units should monitor and evaluate progress.

## Conclusion

More than ever, the competent collection and timely dissemination of quality data and information for decision-making are necessary to improve water sector performance. To help achieve this, sector leadership needs to orchestrate a viable intervention of reviewing, assessing, and analyzing business processes, as well as identifying the business requirements, the data required, and the data owner for each portion of the process. This will be followed by embedding quality assurance activities in data collection and data entry functions to ensure a better quality of data. With a sector faced with intense water scarcity, innovation can bring new solutions to long-standing but worsening problems. By making improvements to the system and increasing the capacity of leadership and staff to implement these changes, the overall quality of water data for decision makers will improve. Knowledge of water solutions and developments globally accompanied by new and expanded collaboration with the private sector and academia can further drive and scale innovation.

## 11 WATER-ENERGY-FOOD-ENVIRONMENT NEXUS

In addition to the fundamental responsibilities to manage Jordan's water supply, water use, sanitation, and services, the water sector plays a vital role in the water-energy-food-environment Nexus, being impacted by it and directly impacting it. This Nexus can contribute to helping Jordan confront significant challenges from climate change, rapid urbanization, population growth impacts on consumption patterns, and economic growth, requiring these sectors to utilize the Nexus approach which represents a framework for the affected sectors to assess impact, coordination, and synergies and to reconcile their respective interests. It also enables holistic and sustainable resources management and promotes the preservation of Jordan's fragile ecosystems. The WEFE Nexus approach also creates a platform for agreement on competing uses of energy, land, and water resources.

### Current Situation

Jordan lies in a region considered a hotspot in terms of climate, environmental and social changes and the acceleration of spatial and temporal changes that severely affect its water resources and its agricultural and food systems, as water, energy, food and the environment are basic pillars of sustainable development, and any imbalance in any of these sectors results in serious effects on the rest of the sectors and development in the Kingdom in general. What increases the challenges in the face of sustainable development are some unsustainable agricultural practices, overexploitation of natural resources, population growth, new lifestyle behaviors demanding additional resources, and low profitability of smallholders using water for agriculture. **Water** strategic resources in Jordan, naturally limited in quantity, are degrading due to overexploitation driven by the need to provide for an increasing population, growing urbanization, and other development needs. **Energy** prices, a major cost item in the production and transport of water (nearly 50% of operational costs) are rapidly increasing at unpredictable rates. Furthermore, energy production remains mostly a major contributor to greenhouse gases.

**Food** production and delivery are subject to the availability and quality of water, as well as access to energy at reasonable costs for groundwater pumping and for transport of products both locally and internationally.

**Environmental** standards are applied to the treatment of wastewater before further use. The quantity of water thus reclaimed is perpetually increasing with the increased use of water and the expansion in wastewater networks. Biodiversity also needs water for its natural habitat and for the prevention or delay of desertification. Climate change is changing the frequency and severity of rainfall. Furthermore, new resources such as desalination are energy intensive with a noticeable contribution to the carbon footprint.

Currently, management and development of each sector are mandated to its own separate ministry. Each ministry has its own goals and objectives. The success or failure of each sector is measured independently without due consideration to the other sectors. This sector-based resource management approach fails to recognize and capture the linkages between these highly interconnected sectors. Water and Agriculture is a directly inherent nexus, and sectors like energy, environment, finance, and others where interdependencies exist can also be part of the nexus management approach. This better identifies shared challenges and where trade-offs and synergies exist between sectors to reconcile competing interests.

In recognition of this critical need, the Government of Jordan has called for the establishment of a Coordination Council from the four ministries in the Jordan Economic Vision Document of June 2022. The aim is to facilitate projects to be jointly developed by two or more sectors or through the Coordination Council as an overarching entity. All new or planned WEFE Nexus projects will demonstrate coordination activities between the sectors during project conceptualization. Intersectoral design, planning, implementation, and operation are to be jointly proposed. Benefits are to be described and quantified as to what the cooperation will yield to each sector individually yet more so toward national development, while also targeting what can be achieved in terms of SDGs.



The main challenges in operationalizing the WEFE Nexus are: (i) extending knowledge on interlinkages and potential impacts between Nexus sectors; (ii) moving toward holistic analysis which provides coherence between activities of different sectors such as land use and spatial planning, and promoting a socially acceptable allocation of resources; (iii) considering the interests and requirements of all sectors when making decisions; (iv) identifying and validating solutions which alleviate Nexus conflicts, and (v) developing and evaluating measures to effectively overcome social, behavioral, economic, or technical barriers that hinder a real implementation of the Nexus approach.

It should be noted that recent efforts were made to establish coordination networks between the water and energy sectors through a Joint Group comprised of MWI, MEMR, WAJ, JVA, National Electric Power Company (NEPCO), Energy & Mineral Regulatory Commission (EMRC), MoF, and MoPIC Secretary Generals. The objective is to enhance and support national efforts regarding the reduction of energy costs to the water sector and the sustainability of the electricity grids.

## Key Challenges, Considerations, Opportunities, and Threats

The main challenge of the integrated management under the WEFE Nexus approach is that the entire governance structure in the country is based on sector-led management and policies, despite the establishment of some cross-sectoral committees between sectors to coordinate activities. Yet, each sector continues to focus on its specific goals and KPIs without considering the impact of such goals on other sectors. Therefore, a framework for true joint management of nexus projects which enables integration is necessary to ensure that the resources feeding these sectors are truly optimized toward sustainable development of the country.

The WEFE Nexus approach is also important in addressing Jordan's environmental vulnerability and agricultural sector constraints driven by limited natural resources to meet current population growth demands. These vulnerabilities lead to implementation of strategic national projects to improve water and food security, such as the NCP. These projects are expected to increase the share of affordable and clean energy sources through including a commitment from developers to involve clean energy as potential sources in project operation, which would require efficient technology tools and management of systems, as well as institutionalization of the WEFE Nexus approach.

Finally, energy presents one of the most compelling cases for WEFE Nexus management. Jordan's water sector is one of the largest consumers of electricity that uses it continuously all day to supply water almost at full capacity to meet the increasing demand particularly during summer period, making it difficult for the water sector to minimize pumping water during the power peak load period. Also operationally, it is not good practice to turn off and on pumps as it causes problems to the pumps and the water system infrastructure. Thus, raising the needs to jointly explore other options to neutralize the increased power load during the peak period.

On the electricity tariff side, it has been changing annually, with increases by a factor of three from 2008 to 2019 to reduce the subsidy on the electricity sector while on the other hand further subsidy has become needed for the water sector. Thus, the water sector entities continue to show operational deficits and a compounded legacy debt due, largely to energy costs. This is not resolved by simply reducing the electricity tariff applicable to water operations through a cross-subsidy as this still ends up as government debt. Instead, the country needs to find ways to reduce the cost of production of electricity utilized by the water sector, such as allowing the water sector to develop its own energy sources if the cost is lower than purchasing power from the electricity companies. The options for solar energy need to be fully explored to determine suitability to the water sector. For example, energy is required to pump and distribute water 24/7, but energy production can be limited to daylight hours. Storage is becoming more viable while wheeling through electric transmission grids can handle the additional loads in some cases. Additionally, most water sector facilities



are connected to the high voltage grid not the distribution grid making the cost of electricity provision lower than normal customers, which eventually should be considered while setting the electricity rate for pumping.

This results in the need for developing an energy overall plan for water built around the national water master plan and the energy master plan. In the context of competition and revenue needs, this strategy element will only work if implemented according to a nationally agreed strategy with dedicated political leadership.

## Goal 1: Institutionalize Effective Management of the Water-Energy-Food-Environment (WEFE) Nexus to Drive Synergies, Leverage Investments, Develop Nexus Projects, Ensure Coherent Policies and Regulations, and Conduct Complementary Planning across These Sectors

Although energy costs are overly critical to the sustainability of the water sector, integration needs to extend beyond energy costs to exploring opportunities for win-win solutions in joint projects that are readily financeable such as pump storage, and electric load management. This will require that legal and regulatory frameworks supporting nexus solutions are in place.

New technologies promise to accelerate Sustainable Development Goals and enhance security of water, energy, and food sectors. In the WEFE Nexus approach, use of advanced technology is an important pillar that must be explored to its fullest. Technology innovations in advanced renewable energy, efficient agriculture techniques, in desalination and in advanced treatment of wastewater promise benefits toward achieving food and water security.

Below is the NWS goal for the Water-Energy-Food-Environment Nexus and its corresponding objectives, indicators, targets, and timelines.

### Objective

Goal 1: Institutionalize effective management of the Water-Energy-Food-Environment (WEFE) Nexus to drive synergies, leverage investments, develop nexus projects, ensure coherent policies and regulations, and conduct complementary planning across these sectors		
Indicator/Target: WEFE Council is established, and nexus coordination and management is sustained and utilized resulting in aligned policies and joint projects		
Objectives	Indicators/Target	Timeline
<b>Objective 1.1:</b> Institutionalized WEFE entity with a strong charter and mandate to work effectively across these sectors and in coordination with the Ministry of Finance and MoPIC	WEFE Council is established, and its coordination mechanism is functioning effectively	2024
<b>Objective 1.2:</b> Mainstream WEFE into water sector policy and management	Water sector policies and strategies regularly updated to align with the Water-Energy-Food-Environment (WEFE) Nexus and identify win-win opportunities and shared priorities that minimize trade-offs across the sectors	From 2025
<b>Objective 1.3:</b> Develop and advocate for innovative WEFE projects that integrate water, energy, food, and environment considerations	WEFE project funding secured and project activities underway	From 2023

## Strategic Approach

To implement the goal and objectives of the WEFE Nexus, the water sector will undertake the following strategic approach. The actions are intended to introduce the required positive change to this critical area of cross-sectoral planning, management, and oversight that is appropriate and practical for the current water, energy, food agriculture, and environment institutional and legal frameworks and management structures.

The most essential element from a nexus perspective is the shift from a solely sector-specific approach to an approach that integrates cross-sectoral management and lateral solutions, which requires strong political support, leadership and commitment of concerned Ministries through implementation of activities that achieve targets, change current policies and approaches, and overcome challenges of the desired change.

One effective step will be to develop a summarized joint WEFE Nexus plan that includes a declaration of commitment to implementing the goals and objectives of this plan, with identification of the departments that shall be involved in the implementation. This summarized plan should be communicated both internally within the four involved ministries (MWI, MoA, MEMR, and MoEnv), ensuring the integration of the plan in the Ministries' own policies and plans to support its implementation, and externally (like other Ministries, funding agencies and the public).

## Institutional Roles and Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

To effectively implement the package of reforms and approaches, it is essential that each concerned institution has a clear understanding of their unique and shared roles and responsibilities, as well as responsibility of implementing the WEFE Nexus plan, as roles must be assigned to specific departments to implement the planned goal and objectives. Recently, the responsibility for coordinating and supervising this Nexus has been assigned to the Ministry of Planning and International Cooperation.

Institutions	Key Institutional Roles
<b>MWI</b>	- Playing the role of political leadership and planning for the water sector.
<b>MWI, MEMR, MoA, MoEnv</b>	- Advocacy for establishment of the WEFE Nexus Council and active participation in it - Building institutional capacities and providing a sufficient number of employees for interdependence within the four sectors - Development and implementation of joint projects - Shift to cross-sectoral management
<b>MoPIC</b>	- Chair the Nexus Council with high level participation in it. - Support the development and implementation of joint projects

### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
- Secretary Generals of the four ministries - Supporting staff from each ministry that have project development experience and access to information	- MWI to allocate the required funds	- Seek Technical Assistance for initiating the Council structure - Educate the Council on its roles and responsibilities - Reach full understanding of what a Nexus project entails

## Monitoring and Evaluation

The MWI shall oversee monitoring progress against the goals, objectives, and targets as agreed by the WEFE Nexus council inside the water sector and work with its entities to ensure that each entity carries out its agreed responsibilities toward achieving the set targets. MWI will also facilitate the internal coordination among the water sector entities and the external one with the other sectors. MWI will investigate deviations from planned progress and work with the stakeholders to take corrective actions. These corrective actions shall be added to the action plan and become part of the new improvements for the following period and subject to the monitoring and evaluation plan which creates a case of continued improvement at each monitoring and evaluation cycle.

## Conclusion

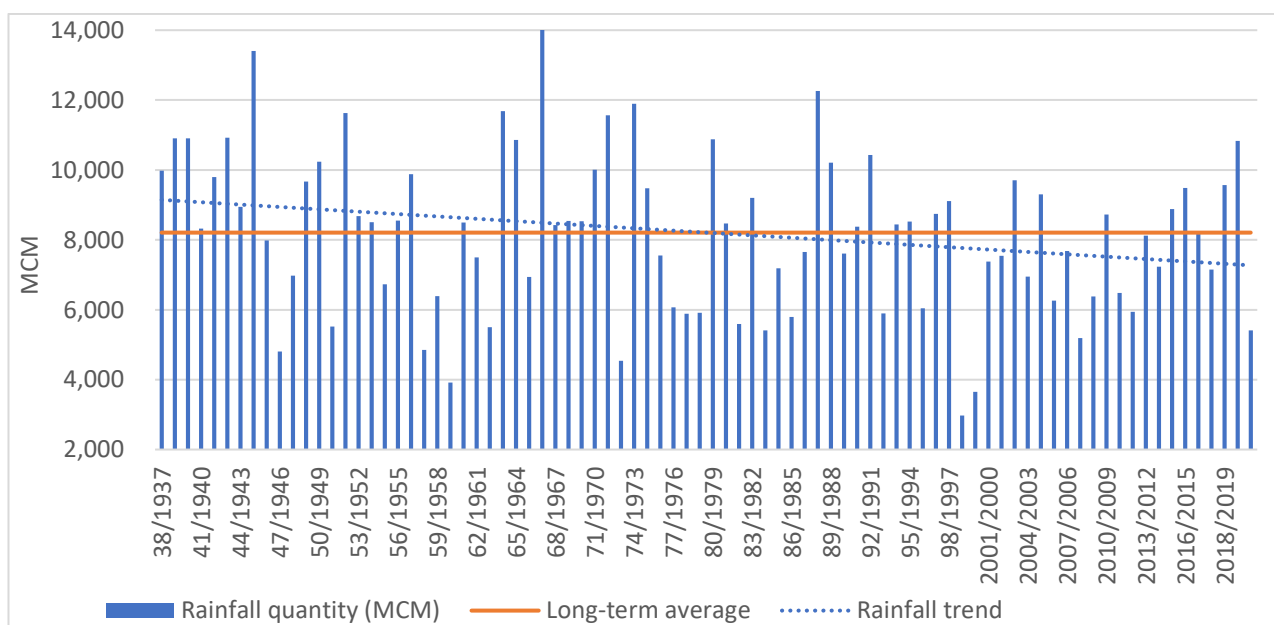
The Nexus Council and its institutionalization is a major step forward. This novel experience needs support from the respective ministries, government, and non-government parties, through which it becomes necessary to transit toward cross-sectoral thinking that will enhance the integrated and comprehensive planning approach and align the WEFE sector plans. This will also provide the mechanism to optimally manage Jordan's water and energy resources that improve the financial and economic benefits for these sectors.

## 12 CLIMATE CHANGE RESILIENCE

Climate change exacerbates the sector's challenges represented in the existing water scarcity that Jordan suffers from. The sector will develop and implement a policy to address and mitigate the accelerating impacts of the climate change and take radical steps to adapt to changing conditions that directly affect water resources and build resilience to the impacts imposed by climate change. The sector will depend on innovation as one of the many tools employed and implement measures such as wastewater reuse and desalination of brackish water and seawater along with better modeling to anticipate and mitigate threats.

### Current Status

Climate change poses a major risk, with potentially significant consequences, to people, the economy, and ecosystems. For Jordan, the threats from climate change are due to extreme weather conditions and variability, Erratic rainfall, drought, increasing temperatures, high evaporation rates and depleting groundwater recharge which affect every aspect of life. The most significant effects of climate change are felt by the water sector where the impacts are accelerating, and irrigation water is declining. The agricultural sector, the largest water user in Jordan, is also particularly threatened by climate change and its impacts. The government has prepared a climate change policy and developed key national documents such as the updated Nationally Determined Contributions (NDCs)<sup>52</sup> (MoEnv, 2021), the National Adaptation Plan (NAP)<sup>53</sup> (MoEnv, 2021), and the Jordan Third<sup>54</sup> and the Fourth (under development) National Communication on Climate Change<sup>55</sup> (MoEnv, 2014), to address these threats, and contribute to building an economy that reduces carbon and increases climate resilience. Historical trend of rainfall quantities over the last 84 years showed a clear decline of around 20% as illustrated in Figure 45.



**Figure 45: Historical Trend of Rainfall Amount over 1937-2021 (2021 Annual Water Budget, MWI)**

<sup>52</sup> [chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://faolex.fao.org/docs/pdf/jor205905E.pdf](https://chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://faolex.fao.org/docs/pdf/jor205905E.pdf). The NDC is a non-binding national plan highlighting climate change mitigation, including climate-related targets for greenhouse gas emission reductions. These plans also include policies and measures that GoJ aims to implement in response to climate change and as a contribution to achieve the global targets set out in the Paris Agreement.

<sup>53</sup> [http://moenv.gov.jo/ebv4.0/root\\_storage/ar/eb\\_list\\_page/final\\_draft\\_nap-2021.pdf](http://moenv.gov.jo/ebv4.0/root_storage/ar/eb_list_page/final_draft_nap-2021.pdf)

<sup>54</sup> [http://www.moenv.gov.jo/ebv4.0/root\\_storage/ar/eb\\_list\\_page/jordans\\_third\\_national\\_communication\\_report-0.pdf](http://www.moenv.gov.jo/ebv4.0/root_storage/ar/eb_list_page/jordans_third_national_communication_report-0.pdf)

<sup>55</sup> These National Communications are prepared periodically and submitted by the countries in response to the UN Framework Convention on Climate Change, which contain information on greenhouse gas emissions in the country and describe the steps that have been taken and are intended to be taken to implement the Framework.

Water management challenges will increase with less anticipated rainfall and increasing temperatures and evaporation, with more extreme weather events and potentially worse seasonal water shortages and floods, that become harder to predict as the Fourth National Communication (4NC) climate change projection indicated warmer and drier conditions for the period 2027-2100 as shown in the following table (MoEnv, 2022).

Trend	Details
Observed trends	Increasing temperature (0.03 C/yea), decreasing precipitation (0.6 mm/year), increased relative humidity (0.08%/year), increase in potential evapotranspiration (17.1 mm/year)
A warmer climate	Increasing in minimum temperature by 1.2 °C according to Representative Concentration Pathway (RCP) 4.5 and 2.7 °C according to RCP 8.5. Similarly, the maximum air temperature is very likely to increase by 1.1 °C and 3.1 °C according to RCP 4.5 and RCP 8.5 respectively
A drier climate	The country is very likely to become drier as the precipitation tends to decrease by 15.8% and 47% according to RCP 4.5 and RCP 8.5 respectively, and the whole country is projected to become drier according to RCP 8.5
Reduction in surface runoff	Surface runoff is expected to decrease by 12% to 30% all over the country during the period 2020 to 2050. MWI estimated that the surface runoff will decrease by around 15% by 2040 to be about 340 MCM (NWMP 2021)
Reduction in groundwater recharge	Groundwater recharge will be reduced by 12% to 29% all over the country during the period 2020 to 2050. Like the SW, GW recharge will decrease by 15% to be 240 MCM by 2040

Other specific climate change impacts on Jordan's water resources are outlined below.

**Reduced water quality.** Lower precipitation accompanied by higher temperature will mean that salinity in surface and groundwater will rise, affecting water quality. More frequent droughts as well as floods will also affect surface water quality.

**Strain on water supply and sanitation sector infrastructure.** Usually, water pumping stations and wastewater treatment plans suffer during floods, as some of them stop operating and some water mains get damaged, capacity of wastewater treatment plants are often exceeded, increased turbidity of surface water effects on the portal water treatment plants performance, leading to a switch to alternative and less reliable water resources.

**Increased water demand.** Higher summer temperatures raise the demand for municipal and irrigation water.

**Reduced water supplies for rainfed agriculture.** Around 61% of Jordan's cultivated area is rainfed. The duration and frequency of consecutive dry days will increase, particularly in the western region, which will affect the viability of rainfed agriculture and probably reduces its area.

**Disruption from more frequent flooding events.** The number of heavy precipitation days is slightly increasing, particularly in the south, leading to increased flooding disruptions and damages.

## Key Challenges, Considerations, Opportunities, and Threats

Adapting to climate change may require modifications to existing policies and programs and, in some cases, the development of new policies and management approaches, which makes it imperative for the sector's institutions to deal with adaptation in a comprehensive manner, and to consider it an important input in the planning and decision-making processes, which allows for increased efficiency in the use of financial and human resources and deepening understanding of the interaction between climate change and many other factors and forces that shape our world. Despite the enormous progress in addressing the water challenges

for Jordan, some key issues remain that could limit Jordan's ability to ensure a water-secure future in the context of climate change. The water sector needs to work on the following:

- Awareness and knowledge of climate change impacts in relation to water resources management and development must be mainstreamed into all water-related communications and outreach events and campaigns at local and national levels, through TV spots, radio, and media campaigns.
- Increase the capacity to develop and utilize climate and rainfall models to predict the likelihood of different scenarios more accurately for the water sector is very limited.
- Develop a data management system for collecting and sharing data on water resources and associated climate change issues which is a critical component of building adaptation and mitigation capacity across stakeholders.
- Mobilization of secured financial resources needed for programs, projects, and research and development on water resources and climate change adaptation or mitigation.

Opportunities	Related Threats/Limitations
<b>Policy, Governance, and Institutional Framework</b> <ul style="list-style-type: none"> <li>- As key water policies are updated, climate change will be mainstreamed for more holistic approaches</li> <li>- Rapidly growing awareness leading to local and international demand to tackle climate change</li> <li>- Leverage national and sector-level efforts to improve cooperation and coordination mechanisms among different sector agencies to apply IWRM principles to climate change adaptation and mitigation</li> <li>- Growing demand for renewable energy as a cost reduction driver for the sector creates mitigation opportunities to switch from fossil fuel generated power to renewable energy development to use in water treatment and pumping</li> </ul>	<b>Policy, Governance, and Institutional Framework</b> <ul style="list-style-type: none"> <li>- Institutional capacity and commitment to execution of current water policies could be further undermined by adding in climate change</li> <li>- Insufficient policies and sectoral investment frameworks for adaptation to climate change</li> <li>- Poor coordination across institutions already hampering the implementation of climate change adaptation and mitigation measures</li> <li>- Climate change requires a broad set of integrated policies, and the weakness of the current institutional capacity of some parties may represent a challenge in implementing the integrated approach</li> </ul>
<b>Financing</b> <ul style="list-style-type: none"> <li>- Leverage climate financing in water sector adaptation projects by aligning projects to climate finance requirements, providing incentives, and encouraging private investors through PPP models</li> <li>- Increasing trust from donors in the sector's commitment and comparative advantage to develop climate change programs and mobilize resources from within the sector</li> <li>- Mobilize projects for different funding windows such as Green Climate Fund (GCF)</li> <li>- The GoJ started advancing some initiatives to capture the climate financing at the local and regional level</li> </ul>	<b>Financing</b> <ul style="list-style-type: none"> <li>- Significant investment is needed to make systems climate resilient</li> <li>- Limited financial resources to address climate change adaptation and mitigation measures</li> <li>- Weak capacity to effectively access climate change finance</li> <li>- Limited Private Sector Engagement (PSE) in climate change adaptation and mitigation</li> </ul>
<b>Capacity</b> <ul style="list-style-type: none"> <li>- Donors are now increasing and integrating climate resilience capacity development into funding</li> <li>- Growing number of research institutions and climate change organizations expanding knowledge and resources to tackle climate change</li> <li>- Media is building awareness</li> </ul>	<b>Capacity</b> <ul style="list-style-type: none"> <li>- Reduction in human resource capacity and brain drain generally across the sector</li> <li>- Limited national capacity in developing and enforcing sectoral adaptation and mitigation measures, especially for water scarcity.</li> <li>- Insufficient resources to address the capacity gap</li> </ul>
<b>Climate Modeling and Analytics</b> <ul style="list-style-type: none"> <li>- Climate change projection study now available</li> </ul>	<b>Climate Modeling and Analytics</b>

<ul style="list-style-type: none"> <li>- Willingness of MWI to improve the existing climate information and knowledge.</li> <li>- Recognition of the need to have an operational early warning systems for drought, flash floods and extreme weather conditions</li> <li>- Universities have strong research capabilities in climate change and water resources modeling</li> <li>- Updated Nationally Determined Contributions (NDCs) create a way to introduce and execute technologies in water work development</li> <li>- There are open-source tools to estimate, capture, assess and control Greenhouse Gas (GHG) in the water sector such as carbon emissions assessment and monitoring (ECAM) tools and monitoring reporting and verification (MRV) systems</li> </ul>	<ul style="list-style-type: none"> <li>- Lack of data availability, consistency and transparency needed to develop climate scenarios</li> <li>- Weak national capacity and lack of capital investment to improve climate information systems and use and downscale regional climate models</li> <li>- Lack of national experts</li> <li>- Little integration of data and analytical tools on climate, water, and agriculture.</li> <li>- Responsibilities for hydrologic and climate data collection, monitoring, and communication are spread across different ministries.</li> <li>- Early warning systems are not operational and have weak coverage.</li> <li>- Lack of preparedness and weak management and coordination during extreme events.</li> </ul>
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## Goal 1: Jordan's Water Sector Is Resilient to the Changing Quantity and Quality of Water Resources and to the Level of Threat to Sector Infrastructure and Operations from Climate Change

Water resources have complex responses to climate change, which are incompletely understood and thus only partially incorporated into future projections of water resources availability and management strategies. It is vital that the specific effects and risks from climate change on Jordan's water resources is not just well understood but that the sector has adjusted and responded to ensure resilience in the face of these changes to strengthen water security. In addition to water resources, weather events and other impacts of climate change are also affecting the water and wastewater infrastructure and their operation. Specific adaptation, mitigation, and management strategies are essential to ensure that these valuable resources are not damaged or degraded because of climate change.

### Objectives

Goal 1: Jordan's water sector is resilient to the changing quantity and quality of water resources and to the level of threat to sector infrastructure and operations from climate change		
Indicator/Target: Climate data along with adaptation and mitigation measures fully integrated into sector management, planning, investments, and policies		
Objectives	Indicators/Target	Timeline
<b>Objective 1.1:</b> Institutionalize the capacity to analyze climate data as part of water resources data to effectively manage the impacts of climate change on resource quality and quantity	Staff with climate change qualifications and analytical capacity are included as part of all relevant government and utilities responsible for data collection and analysis.	2025
<b>Objective 1.2:</b> Leverage climate finance to ensure water and wastewater infrastructure is climate resilient, and to minimize severe impacts of climate change	Climate financing attracted to water sector investments and steadily increases to reflect the needed linkages between achieving water security and managing climate change	From 2024
<b>Objective 1.3:</b> Update and maintain drought and flood management	Improving flood and drought early warning systems to reduce flood risks; coverage of drought warning system across Jordan; staff training; public outreach to improve awareness	2025



systems to reflect changing climate conditions and mitigate possible risks	of changing flood and drought risks and mitigation measures needed	
<b>Objective 1.4:</b> Integrate climate considerations into policies, institutional reforms, planning and management of shared water resources with neighboring countries	Linked to IWRM and Environmental Protection strategic area <i>Objective 3.3: Strengthen transboundary water mechanisms to improve cooperation and shared resources management.</i> Improved mechanisms and platforms to better respond to and adjust for climate change impacts on shared water resources	From 2025

## Strategic Approach

Many of the strategic approaches outlined below are in line with and built on strategic approaches described in several other chapters in this strategy. However, they are highlighted here to emphasize their individual and collective importance specifically in responding to climate change.

***Incorporating climate risks in policy and institutional reforms in the water sector.*** The water sector needs to integrate climate change impacts and adapt to it in all strategies and major planning documents, such as done in the NWMP-3. This will involve strengthening the human, technical, and administrative capacities of the Climate Change units at MWI and related institutions. MWI will adopt risk-informed programming as an adaptation planning tool. The traditional approach of downscaling the Global Climate Models (GCMs) will be combined with a bottom-up approach based on monitoring and assessment of actual trends. This will enable dependable climate change water resources management scenarios with positive signals to be developed and updated to enable robust decision-making.

***Building adaptive capacities.*** The sector will enable water management and governance entities to adapt effectively to changing climate conditions, work on implementing awareness and communication programs to ensure water institutions and water users understand and respond to water-related climate risks and adopt the Climate Resilience Water Safety and Security Planning as a tool to identify adaptation measures at water institutions level. This includes developing a map for identifying areas at high risk of climate change such as flash floods and droughts as a tool for risk assessment and to inform siting of sector infrastructure.

***Building resilience and reducing vulnerability.*** Water resources management needs to integrate identification of the vulnerability of surface water and groundwater basins to climate change and develop adaptation measures and strategies that ensure protecting vulnerable people. This will include strengthening institutionalization and deployment of existing drought and flood early warning systems, planning around forecasted drought impacts, warning of them and taking necessary adaptation measures.

***Research and development.*** Climate science continues to evolve and develop rapidly as the world rushes to meet the global climate crisis. Jordan needs to expand research and analysis to ensure the efficacy of water adaptation approaches over the long term and develop effective approaches. Monitoring and evaluation of water and climate data must be prioritized, and standardized reporting protocols should be agreed upon and implemented under the coordination of MWI and JMD. The adequacy of the weather, environmental, hydrological, and hydro-geological monitoring system must be substantially improved. Research into existing gaps in scientific understanding such as impact studies on sedimentation, groundwater, dam safety, flooding, and infrastructure sustainability should be initiated using the appropriate modeling tools. Impact studies should also be conducted for all catchments along with further research to increase the accuracy of possible future climate change modeling.

***Adaptations for water supply.*** Decreasing overall rainfall will mean less vegetation cover and higher degree of erosion, causing more sediment inflow in dams. Therefore, sediment management and removal programs in dams are urgent. Immediate measures will be taken to accommodate changes in the quantities and variability in water supplies. Water storage capacity in natural dams and water retention systems will be increased so greater water quantities from heavy storms is captured and not lost to runoff. Water

conservation, water demand management, and NRW reduction will be prioritized. Expansion in desalination programs for drinking water and irrigation will continue. Rainwater harvesting should be encouraged from rooftops and with grey water reuse in urban areas for businesses and households. The sector also needs to maximize the use of non-conventional water sources, especially treated wastewater, and prioritize recovery of groundwater aquifers.

**Climate financing.** Sources of climate financing are growing which presents an opportunity for water sector adaptation and mitigation investment. MWI will work on strengthening the capacity of the Climate Change Units to be able to attract this financing, developing a resource mobilization strategy, and establishing and streamlining monitoring and oversight systems for all sources of internal and external climate funding, and strengthening the private sector's role as a partner in green investment.

**Flood protection and infrastructure safety.** Floods are increasing in frequency and severity during some seasons. Therefore, the water sector will develop improved flood early warning systems in critical catchments. All water entities must update asset and investment plans to climate-proof infrastructure.

**Watershed management of water resources including transboundary water.** An area of focus should be rehabilitation and restoration of key watersheds in Jordan to improve retention of surface water and recharge to groundwater. Protecting these resources will be strengthened by enforcing laws to prevent dumping and create incentives for cleanup and restoration of watersheds and basins. Further efforts will work to protect and restore critical water ecosystems, including forests, wetlands, rivers, aquifers, and dams. Transboundary cooperation will emphasize pragmatic management plans for shared watersheds.

**Green Growth actions.** In 2021, Jordan launched the Water Sector Green Growth National Action Plan 2021-2025. The sector will incorporate implementation of the strategic actions for climate change adaptation and mitigation including an emphasis on mainstreaming climate change across the sector and building private sector engagement in developing a green economy.

**Circular Economy.** This strategy promotes the application of circular economy principles to water systems and incorporation of sustainable water management in other sectors' circular economy initiatives. It is important to explore and leverage the relationship between the principles of circular economy and sustainable water management to establish a common language that will enable effective cooperation.

## Institutional Roles, Responsibilities, Resources, and Requirements

### *Institutional Roles and Responsibilities*

Addressing climate change effects requires the sector's entities and across the government to play a critical role in a holistic and comprehensive way to achieve this goal. MWI will be central to mainstreaming climate change adaptation into policy, planning and oversight for the water sector. Civil society organizations will also play a vital role in strengthening public awareness of the need for adaptation and in bridging gaps between scientific research and policy-making. Donor agencies can contribute by mainstreaming adaptation into their development cooperation programs such as screening funded activities for climate risks, providing access to new adaptation technologies, and directing new resources to help absorb the additional costs of adaptation.

Institutions	Key Institutional Roles
<b>MWI</b>	<ul style="list-style-type: none"> <li>- Mainstream climate change adaptation into the policy planning process</li> <li>- Establish, equip, and empower climate change unit</li> <li>- Establish a reliable hydrological model that integrates climate change impacts</li> <li>- Improve monitoring of surface water runoff, floods, and drought early warning systems</li> <li>- Implement climate change action plans</li> <li>- Seek funds for climate change adaptation measures</li> </ul>
<b>WAJ</b>	<ul style="list-style-type: none"> <li>- Supports executing the capital investment for water systems restructuring</li> </ul>

	<ul style="list-style-type: none"> <li>- Explore increasing the monitoring programs for surface water, groundwater, water quality, and climate variables</li> </ul>
<b>JVA</b>	<ul style="list-style-type: none"> <li>- Seeks fund for capital investment</li> <li>- Improves regulatory environment</li> </ul>
<b>Water companies</b>	<ul style="list-style-type: none"> <li>- Participate in capacity building programs</li> <li>- Lead the effort in the objectives related to water demand management, NRW, wastewater treatment</li> </ul>
<b>Donor agencies</b>	<ul style="list-style-type: none"> <li>- Finance</li> <li>- Research and development</li> <li>- Capacity building</li> </ul>
<b>Research community</b>	<ul style="list-style-type: none"> <li>- Research and development for best practices</li> <li>- Capacity building</li> </ul>
<b>Ministry of Environment</b>	<ul style="list-style-type: none"> <li>- Follow up on climate change adaptation measures related to NDCs</li> <li>- Secure fund</li> </ul>
<b>Department of Meteorology</b>	<ul style="list-style-type: none"> <li>- Climate trends and predictions</li> </ul>
<b>Media</b>	<ul style="list-style-type: none"> <li>- Public awareness raising</li> <li>- Early warning dissemination</li> </ul>
<b>Civil society and NGOs</b>	<ul style="list-style-type: none"> <li>- Local expert</li> <li>- Capacity building</li> </ul>

#### *Human and Financial Resources and Requirements*

Human Resources	Financial Resources	Requirements
<ul style="list-style-type: none"> <li>- MWI Climate Change Unit leading implementation and coordinating across WAJ, JVA, and water companies</li> <li>- Continued leadership of the National Climate Change Committee (NCCC).</li> <li>- Focused inter-sectoral task force to facilitate implementation of adaptation measures is recommended with representatives from: ministries, climatology, disaster experts, NGOs, academia, community leaders, media, and research institutions</li> </ul>	<ul style="list-style-type: none"> <li>- Capital investment for water system restructuring or upgrades to be climate resilient</li> <li>- Donor agency funding</li> <li>- GCF and other climate funding sources</li> </ul>	<ul style="list-style-type: none"> <li>- MWI prioritization of climate change adaptation</li> <li>- Integration of adaptation across water sector policies and strategies</li> <li>- Sector's capacity to implement</li> <li>- Water resources protection and management to ensure effective, equitable, and sustainable adaptation and mitigation</li> </ul>

## **Goal 2: Jordan's Water Strategy Fully Reflects the Need to Adapt to and Mitigate against the Impacts of Climate Change**

The NWS takes into account, even if not explicitly stated the climate change issue that is fundamentally affecting the integrity of Jordan's water resources and challenging the sector's capacity, systems, and infrastructure. The table below summarizes how each area of the strategy has addressed climate change.

Goal 2: Jordan's water strategy fully reflects the need to adapt to and mitigate against the impacts of climate change	
Indicator/Target: Climate change and its impacts are an integral part of every area of the national water strategy	
National Water Strategy area	Where and how climate change is addressed / integrated throughout the NWS

<b>Water Supply and Demand Balance</b>	<p><b>Objective 1.1:</b> Strengthen the management of bulk water as a national system to optimize any needed transfer of water between governorates—recognizes that the source, quality, and quantity of supplies are changing because of many factors, including climate change</p> <p><b>Objective 1.5:</b> Responsibly develop viable groundwater resources based on regular and reliable hydrological and environmental analysis—this analysis includes climate data to determine viability</p> <p><b>Objective 2.4:</b> Eliminate over-abstraction of groundwater used for irrigation (see IWRM and Environmental Protection, Goal 1)—protects threatened groundwater resources that are already severely affected by reduced rainfall and recharge due to climate change</p>
<b>IWRM and Environmental Protection</b>	<p><b>Objective 1.1:</b> Eliminate groundwater over-abstraction through the regular and reliable analysis of safe yield levels linked to licensing and the water budget for all aquifers—safe yield analysis includes more frequent measurement of water resource characterizations to track pace and severity of climate change impacts on groundwater</p> <p><b>Objective 2.1:</b> Increase surface water storage capacity through both improvements to existing facilities and new capacity—adaptation for higher temperatures, lower rainfall, and increased variability of supply</p> <p><b>Objective 3.1:</b> Strengthen shared groundwater basin management—integrates climate data and adaptation into shared water management as climate changes are not restricted to geo-political borders</p> <p><b>Objective 3.3:</b> Strengthen transboundary water mechanisms to improve cooperation and shared resources management—improves the mechanisms and platforms to better respond to and adjust for climate change impacts on shared water resources</p>
<b>Irrigated Agriculture</b>	<p><b>Objective 1.2:</b> Coordinate closely with the Ministry of Agriculture to manage irrigation water allocations, policy, and incentives—to ensure that cross-sectoral policies and practices also reflect the reality of climate change impacts on water supplies</p> <p><b>Objective 1.3:</b> Expand linkages with academia, research institutions, the private sector and donor programs to drive innovation throughout the sector—ensures that latest academic research and analysis of climate change is available to water sector authorities</p>
<b>Utility Infrastructure Management and Operation</b>	<p><b>Objective 1.2:</b> Improve efficiency of network operations and maintenance to achieve continuous supply with minimal water losses—ongoing improvements to operations and maintenance integrate climate resilient infrastructure planning and management</p>
<b>Energy Efficiency and Renewable Energy in the Water Sector</b>	<p><b>Goal 1:</b> Improve energy efficiency in all water sector operations through better energy management practices to lower costs and improve financial performance of the sector (all Objectives)—energy produced from fossil fuels is a major contributor to climate change; improved energy efficiency mitigates climate change impacts</p> <p><b>Goal 2:</b> Expand the use of renewable energy across water sector operations to lower costs and improve financial performance of the sector—converting to renewable energy supplies directly mitigates against climate change</p>
<b>Sector Governance and Institutional Development</b>	<p><b>Objective 1.2:</b> Regularly and reliably report on sector performance and Water, Sanitation, and Hygiene (WASH) service levels against goals and targets set in the NWS, SDGs, government priorities, and national water budget—relevant climate data as well as progress and performance against climate-related policies and plans is an integral part of sector reporting</p> <p><b>Objective 2.3:</b> Ensure regular coordination across government to align sector planning and water budgets to national strategic priorities, including Ministry of Finance, Ministry of Agriculture, Ministry of Energy, Ministry of Environment, Ministry of Planning and International Cooperation, municipalities, and Ministry of Health—climate change impacts are important factors in planning and management across the government and are an integral part of the water sector’s ongoing coordination</p> <p><b>Objective 2.4:</b> Maintain updated capital investment planning for sector infrastructure needs and critical systems investments—capital investment planning includes investment needed to ensure</p>

	<p>climate resilient WASH infrastructure and identification of where climate financing can be accessed as an additional funding source</p> <p><b>Objective 2.5:</b> Ensure effective donor coordination to leverage the support of international partners, match donor funding to critical sector needs, and avoid duplication in designing interventions—climate change is a top priority across donors as well as the Government of Jordan and climate considerations are part of water sector planning and coordination</p> <p><b>Objective 3.4:</b> Invest in establishing and maintaining staff training and capacity development, particularly in critical areas of project management, contracts management, climate change, NRW, and financial management—water resources management, systems operations, capital planning and other key technical staff capacities will include training and professional development on climate change considerations that are key to lasting water security</p>
<b>Financial Sustainability</b>	<p><b>Goal 1:</b> Achieve full cost recovery of municipal water and wastewater services operations and maintenance (O&amp;M) and Build Operate Transfer (BOT) costs—because of declining freshwater resources, large-scale water development projects are required to meet growing demand, but these projects are expensive and must be carefully managed for financial sustainability to enable the sector to afford these kinds of needed adaptation measures for climate change impacts on the water sector</p>
<b>Innovation, Technology, and Private Sector Engagement</b>	<p><b>Goal 1:</b> Utilize technology across the sector to improve the accuracy and timeliness of data collection, strengthen data analysis, and streamline management systems—climate data, evolving models, and technological solutions to enable better climate change adaptation and mitigation are key elements of utilizing technology throughout the water sector</p> <p><b>Objective 2.1:</b> Leverage private sector investments to introduce and expand water technologies—investments include climate-related investments that include water-related goals and outcomes</p> <p><b>Goal 3:</b> Private sector participation increased to improve operational efficiency and sustainability, introduce innovation and technology, access higher flexibility in execution, improve risk management, and access to alternative funding—private sector participation that includes water-related improvements and risk reduction</p>
<b>Water-Energy-Food-Environment Nexus</b>	<p><b>Goal 1:</b> Institutionalize effective management of the (WEFE) Nexus to drive synergies, leverage investments, develop nexus projects, ensure coherent policies and regulations, and carry out complementary planning across these sectors—each area of the nexus is significantly affected by climate change and so all aspects of WEFE Nexus strengthening and interventions include climate change</p>

## Monitoring and Evaluation

Climate change adaptation is a dynamic process that is periodically evaluated and updated, particularly given how quickly impacts appear due to climate change, urging the implementation of actions to manage climate risks, adapt with as much knowledge as possible, and to forecast impacts and ensure continuous effective development. Successful implementation of the NWS and its climate provisions means not only applying appropriate methodologies, policies, and sufficient funding, but also requires stronger awareness, political will, institutional frameworks, data collection and management, and local capacities. The Climate Change Unit within MWI shall be responsible for monitoring the progress of this strategic area.

## Conclusion

Climate change affects all activities of the water sector in Jordan from water supply to flood and drought management. Rising temperatures, decreasing precipitation, extreme events such as heat waves, flood and drought are just some of the impacts of climate change that have broad implications for hydrological water cycle components and management of water resources. Therefore, measures to adapt to the effects of climate change should be taken to ensure continued economic, social, and environmental development, provide institutional capacities to respond to it, educate society about it, and raise awareness about its risks.

## 13 ANNEXES

### ANNEX 1: SDG 6 – Clean Water and Sanitation

The components of this goal are managed through the Ministry of Water and Irrigation (MWI), the Water Authority of Jordan, the Jordan Valley Authority, and the water companies, in cooperation with the Ministry of Agriculture, the Ministry of Environment, many governmental institutions and the private sector, in addition to civil society organizations, donors and United Nations organizations. The sixth goal of the Sustainable Development Goals is monitored by MWI through meetings, workshops, conferences, official correspondence, reports, studies, data collection and knowledge exchange.

The MWI which has the full responsibility for water and sanitation, and projects related thereof, in collaboration with water sector entities, will elaborate specific targets and indicators that are in harmony with SDG6, providing continuity while expanding their scope and refining definitions. These targets and indicators will be moderated to reflect the current Jordanian water situation and adopted for use in the monitoring and evaluation mechanism in all sector-related institutions and in performance reporting.

Jordan, selected in the two reporting rounds to be a pilot country for assessment of the reporting process due to its commitment to follow SDG 2030 Agenda, has recently completed its second Voluntary National Review of the national progress made in implementing the 2030 Agenda for Sustainable Development (2030 Agenda). Table 10 shows MWI's SDG6 achievements until 2020 and targets to 2030 and summarizes the linkages of each SDG indicator with NWS's Goals and Objectives, where those indicators are address in the NWS. To ensure target achievement and continue with accurate monitoring and recording of the implementation of the SDG, the sector will improve the availability of and access to data and statistics disaggregated by income, gender, age, race, ethnicity, migratory status, disability, and geographic location. It is crucial that steps are taken to improve the quality, coverage, and availability of disaggregated data.

**Table 10: SDG6 Achievements Until 2019 and Targets to 2030<sup>56</sup>**

Indicators	Linkage with NWS Goals and Objectives	Baseline 2016	Actual 2019/ 2020	% Change	Targets		
					2024	2027	2030
6.1.1 Percentage of the population using safe-managed drinking water services	Utility area, Goal 1-Objective 1.1	%94.3	%94.6	%0.32	%95.6	%97.8	%100
6.2.1 Percentage of the population that benefits from proper management of sanitation services, including handwashing facilities with soap and water	Utility area, Goal 1-Objective 1.1	%84	%88.5	%5.36	%91	%95	%100
6.3.1 Percentage of wastewater treated in a safe manner	Utility area, Goal 1, Objective 1.1	%64	%64	%0	%67.5	%73	%80
6.3.2 Percentage of water bodies with good water quality	IWRM area, Goals 1 and 2, objectives 1.2 and 2.3	%92	%100	%8.7	%100	%100	%100
6.4.1 Percentage change in water use efficiency over time	IWRM area, Goal 4, Irrigation area, Goal 4	%3	%4	%33.3	Increase	Increase	Increase
6.4.2 Percentage of freshwater withdrawal from the total available fresh water (Water Stress)	IWRM area, Goals 1 and 2, supply-demand area, Goal 3, irrigated area, Goal 3	%133	%138	-%3.76	%129	%116	%100
6.5.1 Percentage of IWRM implementation (0-100)	IWRM area	%63	%66	%4.76	%69	%74	%80
6.5.2 Percentage of the common border areas subject to an effective water cooperation agreement	IWRM area, Goal 3	%21	%23.2	%10.5	%27	%33	%40
6.6.1 Percentage change in the extent of water-related ecosystems over time	IWRM area, Goal 2, Utility area, Goal 3	%17	%3.5	%79.4	Less than %10	Less than %10	Less than %10
6.a.1 The amount of official development assistance related to water and sanitation that is part of a spending plan conducted in coordination with the government	Pillar Goal 1, Objective 1.6, and Pillar Goal 3	%85	%85	%0	%85	%87	%90
6.b.1 Percentage of local administrative units that have well-established operational policies and procedures regarding local community participation in water and sanitation management	Pillar Goal 4, Objective 4.4, Governance Area, Goal 1, Objective 1.3	%16.7	%16.7	%0	%22	%36	%50

<sup>56</sup> Source: MWI, April 2022 - MWI's mechanism for setting targets: a consultative study / expert assessment / assessment of the general situation, and MOPIC (2022) Jordan 2nd Voluntary National Review



### **Challenges to achieving the sixth sustainable development goal:**

Necessary resources are lacking for measurement, follow-up, data collection, roadmap, and plans to achieve the relevant indicators. The indicators are consistent with Jordan's commitment to continuous communication and cooperation in this field with the aim of achieving the 2030 Agenda for Sustainable Development.

### **Enhancing work to achieve the sixth sustainable development goal:**

- Improving the collaboration and synergy between public institutions, especially in data collection, integrated planning and clarified responsibilities.
- Applying the Integrated Water Resource Management approach to ensure a balance between the interests, aspirations, and concerns of internal partners (water sector institutions and external partners (such as citizens and supporting entities).
- Establishment of a special department for sustainable development within the Strategic Planning Unit in MWI responsible for follow-up and evaluation of the objective indicators. A study has been developed to institutionalize work on the monitoring and evaluation processes in this department.
- MWI works to reduce water losses and take advantage of alternative water sources for use by farmers to relieve pressure on fresh groundwater abstraction. Farmers are encouraged to increase water use efficiency and to use reclaimed treated wastewater for restricted irrigation of some crops, especially fodder and trees. As the agricultural sector uses about half of the water sources, but contributes only %3.5 to the GDP, such initiatives are of paramount importance.

### **SDG 6 interdependency with other SDGs:**

SDG6 has a mutual effect with SDG 2 related to Zero Hunger, SDG 7 related to Energy and SDG 13 related to climate change:

- **SDG6-SDG2 interdependency:** water safety and quality control are crucial for food safety and differentiation.
- **SDG6-SDG7 interdependency:** water sector uses about %15 of gross electricity in Jordan; the water sector takes into consideration the significance of energy efficiency and renewable energy into its goals and programs.
- **SDG6-SDG13 interdependency:** climate change highly affects the availability of water resources; water sector has an embedded priority to build resilience and adaptation to climate change, and it integrates climate change measures into policies and planning processes.