

**Economic and Social Commission for Western Asia (ESCWA)**

Committee on Water Resources  
Fourteenth session  
Online, 29-30 September 2021

Item 6 of the provisional agenda

## **Groundwater resources management**

### **Summary**

The majority of Arab countries rely on groundwater resources for most of their freshwater needs. Member States of the Economic and Social Commission for Western Asia (ESCWA) are therefore looking into innovative and integrated governance frameworks to improve groundwater resources management and ensure equitable access for current and future generations to this strategic resource.

Groundwater is central to achieving the goals and targets laid out in the 2030 Agenda for Sustainable Development in the region. Water scarcity is increasing as limited renewable groundwater resources are depleted, particularly by the agricultural sector and increasingly populated major cities. The majority of countries in the region are thus extracting groundwater at unsustainable rates that exceed the natural recharge rates. The projected impacts of climate change on water resources in the region will further increase dependency on groundwater at a time when groundwater recharge is projected to decrease and the quality of groundwater is expected to deteriorate. Transboundary groundwater poses another challenge to water security in the region that requires specialized legal, policy and management frameworks that take into account its non-renewable character and the need for transboundary cooperation.

ESCWA has launched several initiatives in recent years to support member States in the management of groundwater resources including Guidelines for the Management of Groundwater Abstraction in the Arab Region, assessments of the impacts of climate change on groundwater resources and various capacity development activities.

ESCWA is also working to increase access to groundwater knowledge in the region through a digital platform and by providing pertinent analysis and assessments of groundwater resources. The Committee on Water Resources is invited to provide suggestions on further areas of work that it would like the secretariat to pursue.

## Contents

	<i>Paragraph</i>	<i>Page</i>
Introduction .....	1-4	3
<i>Chapter</i>		
<b>I. Groundwater challenges in the Arab region.....</b>	<b>5-15</b>	<b>3</b>
A. Groundwater governance .....	5-7	3
B. Groundwater abstraction .....	8-11	4
C. Transboundary groundwater resources .....	12-13	4
D. Impacts of climate change on groundwater resources .....	14-15	5
<b>II. Initiatives in support of groundwater resources management in the Arab region.....</b>	<b>16-24</b>	<b>5</b>
A. Guidelines for the Management of Groundwater Abstraction in the Arab Region .....	16-17	5
B. Capacity-building on groundwater management in integrated water resources management .....	18-19	6
C. Workshop on Disruptive Technologies for Improved Groundwater Management in the Mashreq Region .....	20-21	6
D. Assessment of the impacts of climate change on groundwater resources.....	22-24	6
<b>III. Prospects and future action.....</b>	<b>25-26</b>	<b>7</b>
A. Mainstreaming groundwater resources management in sustainable development.....	25	7
B. Proposals for future work.....	26	8

## **Introduction**

1. Arab countries rely on groundwater resources for most of their freshwater needs. Groundwater is central to achieving the goals and targets adopted in the 2030 Agenda for Sustainable Development in the region. Groundwater is the most relied on water source in at least half of the 22 Arab States and accounts for more than 80 per cent of freshwater withdrawals in Djibouti, Libya, Palestine and Saudi Arabia. Amid increasing water scarcity, limited renewable groundwater resources continue to be depleted, particularly by the agricultural sector and high population growth in major cities, with the majority of countries in the region extracting groundwater at unsustainable rates exceeding the natural recharge rates.
2. In addition to their excessive use, groundwater resources are also threatened by anthropogenic, agricultural and industrial pollution. The deterioration in the quality of groundwater resources, both due to overexploitation and pollution, will eventually aggravate the problem of water scarcity. It will also increase health risks and harm the environment and ecosystems with associated economic impacts. Combined with the projected impacts of climate change on water resources in the region, this will further increase dependency on groundwater at a time when groundwater recharge is also projected to decrease.
3. Groundwater in the region also tends to extend over large geographic areas and across political boundaries. All Arab States except for Comoros draw upon one or more transboundary groundwater resources. Some of these aquifers are directly connected to surface-water hydrological systems and should be managed within the context of combined hydrological units or drainage basins. Other shared aquifers contain fossil groundwater reserves requiring specialized legal, policy and management frameworks that take into account their non-renewable character.
4. The declining availability of groundwater resources due to increased consumption, development demands, inefficient use and climate change has prompted member States of the Economic and Social Commission for Western Asia (ESCWA) to look into innovative and integrated governance frameworks to improve groundwater resources management and ensure equitable access for current and future generations to this strategic resource. A summary of activities undertaken in this area since the thirteenth session of the Committee on Water Resources and planned activities and proposed recommendations is presented below.

### **I. Groundwater challenges in the Arab region**

#### **A. Groundwater governance**

5. Growing populations, socioeconomic development and climate change are increasing groundwater stress and threatening water security in the region. Groundwater governance limitations in the Arab region complicate responses to these challenges. Regional water scarcity requires a multidimensional integrated approach to groundwater governance that incorporates the social, economic and environmental dimensions while also observing the principles of good governance which include integration, responsiveness, coherence, transparency, participation, accountability, equity and ethics. Governance frameworks in the region contrast between traditional community-based governance modes of such systems as *aflaj* to current State-centred modes of governance, with varying levels of effectiveness.
6. Groundwater governance frameworks define the management of groundwater resources and include an institutional framework, a conducive legal framework, policies, incentive structures and plans aligned with society's goals based on accurate and widely shared knowledge and science. The accompanying institutional framework is characterized by representation and leadership, sound organizations and capacity, stakeholder engagement and participation and working mechanisms to coordinate how groundwater is handled across different sectors. With some exceptions, the governance of groundwater in the region has not kept pace with the rapid changes and increasing demands.

7. A regional diagnostic of the Arab region has shown many challenges and barriers to effective groundwater governance including inadequate or lack of clear groundwater policies and legislation with a lack of political will or inadequate political will for their implementation. In addition, limited dedicated funding has affected management, monitoring and capacity-building. Groundwater institutions have been weak or fragmented, with overlapping responsibilities and weak coordination between relevant sectors. In general, there is an inadequate understanding of groundwater systems, with weak monitoring systems and a lack of information. Community participation has been limited.

### **B. Groundwater abstraction**

8. In the Arab region, water users often benefit from unrestricted access to groundwater resources due to weak regulatory and enforcement regimes. Groundwater resources are often held to be owned together with the land they are located under. This results in a “tragedy of the commons” as groundwater users have little or no incentives to conserve groundwater at the community level or for future generations. This becomes even more complicated in transboundary settings with slow-flowing groundwater, as each well individually does not seem to affect groundwater levels, while as a whole overpumping has a very nefarious effect. Falling groundwater levels are also difficult to observe before it is too late, leaving groundwater to become depleted, saline or too polluted for use. Improved legal, regulatory, enforcement and technological instruments are thus needed to improve groundwater governance and the sustainable management of these essential resources in the water-scarce region.

9. The increased reliance on groundwater resources in the region has led to over-abstraction of groundwater resources in many parts of the region. This has led to a falling water table, especially in highly populated and agricultural areas, and seawater intrusion in many coastal cities.

10. Analysis from the Gravity Recovery and Climate Experiment (GRACE) mission data has shown an overall declining trend in groundwater storage in the Arab region. In fact, groundwater storage anomalies show that the area experiencing a decline in groundwater storage increased by 75 per cent in October 2011 and 100 per cent in October 2018 compared to October 2002 and increased by 65 per cent in April 2011 and 95 per cent in April 2019 compared to April 2002. This not only depicts the alarming trend of decreasing groundwater storage between 2002 and 2019 but also highlights the seasonal variability effect on groundwater storage combined with excessive groundwater withdrawals in the dry season.

11. The challenge of groundwater over-abstraction is most concerning in cases of non-renewable groundwater resources distributed over vast areas of the Arab region and at great depths. The abstraction of non-renewable groundwater resources has been estimated at 317 per cent of the renewable volume in the Member States of the Gulf Cooperation Council. These aquifers must be managed with a view that they are a finite resource requiring close monitoring and innovative approaches that capture their value.

### **C. Transboundary groundwater resources**

12. All Arab States except for Comoros draw upon one or more transboundary groundwater resource, with 42 transboundary aquifers covering almost 58 per cent of the Arab region’s area. Close cooperation is needed to ensure the effective management of these transboundary aquifers. Unfortunately, only very few cases of groundwater cooperation exist in the region. Jordan and Saudi Arabia signed an agreement of cooperation on the Al-Disi/Saq-Ram aquifer in 2015 which aims to ensure proper management, utilization and sustainability of groundwater and established a joint technical committee. Cooperation on the transboundary Nubian aquifer shared by Chad, Egypt, Libya and the Sudan is pursued through a Joint Authority tasked with the study and development of the groundwater. Cooperation and data exchange in the North-Western Sahara Aquifer System (NWSAS) shared by Algeria, Libya and Tunisia is facilitated through a consultation mechanism hosted by the Sahara and Sahel Observatory (OSS).

13. Cooperation and joint management of transboundary aquifers are hampered in many instances by a lack of understanding of the transboundary groundwater system and a lack of accurate data. There is also a lack of dedicated institutions and institutional mechanisms with set funding for transboundary groundwater resources, which limits the long-term visioning and management of these vital resources. Cooperation is further complicated due to the vast geographic extent of transboundary aquifers in the region, requiring an innovative approach to define more manageable units stemming from a common perspective between countries.

#### **D. Impacts of climate change on groundwater resources**

14. The impacts of climate change have been clearly defined on surface water resources in terms of variability and trends in precipitation, evapotranspiration, temperature, surface flow, runoff, flooding and droughts. However, these impacts have not been as clearly understood when it comes to groundwater. Climate change is also directly and indirectly affecting how groundwater can be sustainably managed. Climate change is projected to affect natural recharge rates due to reduced precipitation and increased evapotranspiration in large parts of the region. More intensive rainfall events and flash floods may also reduce recharge in the absence of appropriate management. In tandem, dependency on groundwater resources will increase as climate change affects surface water availability, since higher temperatures and evapotranspiration rates will increase water use in the agricultural sector.

15. In-depth multi-dimensional assessments are needed to clarify the impacts of climate change on groundwater in the Arab region in terms of the decreasing quantity and increasing variability of precipitation and general increase in temperatures. The Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) projections for the Arab region in general and the new RICCAR regional climate modelling ensemble just generated for the Mashreq region can be drawn upon to inform such assessments for groundwater and help to inform related planning and policy dialogues.

## **II. Initiatives in support of groundwater resources management in the Arab region**

### **A. Guidelines for the Management of Groundwater Abstraction in the Arab Region**

16. Draft *Guidelines for the Management of Groundwater Abstraction in the Arab Region* were prepared by ESCWA based on an extensive review of available regulations and experiences in the Arab region in managing groundwater abstraction. The aim of these guidelines is to present model guidelines that address the regulation of groundwater abstraction by drawing on the best available regulations and practices from around the region. In addition, an assessment tool was included to assist countries in assessing how well national regulations and institutional mechanisms align with these guidelines and hence propose improvements to the national regulatory process that are in line with each country's capacities and specificities.

17. The draft guidelines were vetted by ESCWA member States in an Expert Group Meeting held virtually on 4 March 2021. Senior officials from government institutions and technical experts responsible for groundwater resources management in the Arab region provided comments on the draft guidelines and exchanged experiences and best practices in managing and controlling abstraction of groundwater for various uses through regulations, enforcement and innovative technologies. Participants also discussed a proposed set of indicators to assist in evaluating current national and local regulatory and enforcement mechanisms aimed at improving groundwater management in terms of the control and monitoring of abstraction. Several member States submitted to ESCWA an evaluation of their national groundwater regulatory framework based on the proposed indicators issued with the draft guidelines.

## **B. Capacity-building on groundwater management in integrated water resources management**

18. ESCWA organized a series of training webinars on *Groundwater Management in Integrated Water Resources Management (IWRM)*. The trainings are the culmination of collaborative efforts by ESCWA, the Arab Integrated Water Resources Management Network (AWARENET) and the International Network for Capacity Development in Sustainable Water Management (Cap-Net). The trainings were based on the training manual on *Groundwater Management in IWRM* translated into Arabic in coordination with Cap-Net with support from the members of the AWARENET working group on Sustainable Development Goal (SDG) indicator 6.5.1. The trainings aimed to improve knowledge and enhance understanding of the complex nature and intersectoral challenges facing sustainable groundwater governance and management in the Arab region.

19. The trainings were delivered from 2 November to 7 December 2020 through 11 interlinked and complementary modules that explored tools and mechanisms for groundwater management such as institutional arrangements and legislative frameworks as well as groundwater allocation considerations and the use of economic and financial tools for that purpose. The impacts of climate change on groundwater resources were also examined and the potential of information and communication technology in managing groundwater resources was demonstrated as well. At least 100 participants from more than 16 Arab States participated in the training, which was held through a virtual platform.

## **C. workshop on Disruptive Technologies for Improved Groundwater Management in the Mashreq Region**

20. In conjunction with the World Bank, ESCWA organized a workshop on *Disruptive Technologies for Improved Groundwater Management in the Mashreq Region* from 15 to 17 June 2021. This workshop was the third workshop in the Mashreq Waters Knowledge Series launched by the World Bank and ESCWA to foster discussion on opportunities and challenges for utilizing disruptive technologies and innovative tools for improved water resources management in the Mashreq region. The workshop focused on how disruptive technologies could be utilized to inform and improve the management of groundwater in the region in the face of a multitude of challenges including over-abstraction, quality deterioration and climate change.

21. The meeting participants identified challenges, opportunities and innovative approaches for utilizing disruptive technologies for improved groundwater resources management in the Mashreq region. The discussions benefited from the e-book World Bank Mashreq Groundwater Disruptive Technologies, which examines available disruptive technologies and how they could be used to improve groundwater resources management. The meeting also allowed professionals to exchange experiences and best practices in a range of areas, including the use of disruptive technologies groundwater resources monitoring, data management, analysis and visualization and groundwater knowledge frameworks. Finally, the meeting presented examples of disruptive technologies from around the globe that had improved groundwater resources management in order to identify potential opportunities to use these innovative tools for the benefit of the Mashreq region.

## **D. Assessment of the impacts of climate change on groundwater resources**

22. ESCWA has supported efforts to assess the impacts of climate change on groundwater resources through pilot assessments of specific aquifers in various member States in the region. Drawing upon RICCAR regional climate modelling projections to inform hydrogeological modelling, an assessment was performed to evaluate the impacts of climate change on groundwater resource availability and use in the Tadla aquifer system in Morocco, which supplies water for homes as well as large irrigation schemes in the Beni Amir agricultural area. The methodology is based on a three-dimensional conceptual groundwater model, which simulated a comprehensive set of physical processes and was compared, calibrated and verified against observations. Secondly, the outputs of three selected RICCAR climate models were integrated in the groundwater model to simulate the impact of climate change on groundwater from 2020 to 2100. Anthropogenic and climate forcing

based on two scenarios, RCP 4.5 and RCP 8.5, were implemented in order to project impacts of climate change on the groundwater system and long-term impacts on water and crops.

23. The main results of this study confirmed that groundwater resources in the Tadla aquifer will be affected by climate change due to a reduction in natural recharge from reduced precipitation, 20 per cent less at the end of the century for RCP 4.5; and 50 per cent less for RCP 8.5, and the increase in evapotranspiration caused in part by higher temperatures. This is evident in a reduction of the water balance accompanied by a fall in the water table under both scenarios, varying from 10 m for RCP 4.5 to more than 25 m for RCP 8.5, leaving some aquifer areas completely dry.

24. ESCWA has recently launched two similar assessments of the impacts of climate change on groundwater in Iraq and the State of Palestine drawing upon the new RICCAR projection for the Mashreq. The assessment in Iraq will be conducted on the Dammam aquifer and in the State of Palestine it will be conducted on the Eocene aquifer. The results of these studies will inform related planning and policies.

### **III. Prospects and future action**

#### **A. Mainstreaming groundwater resources management in sustainable development**

25. ESCWA is seeking to strengthen capacity in groundwater resources management as a means to advance sustainable development in the Arab region. This is being pursued by increasing regional accessibility to groundwater knowledge products and by providing analyses and assessments of groundwater resources from different perspectives through the following reports and activities:

(a) The ESCWA Water Development Report will focus in its ninth issue on Groundwater Resources in the Arab Region. The report aims to improve understanding of the importance of groundwater resources in the region and the potential for strengthening integrated management and planning of these resources by improving their governance. The publication will provide an update on the state of groundwater resources in the region and major stresses and uses and explore the impacts of climate change on these resources. The publication will also outline approaches for improving their use through innovative management approaches and technological advances;

(b) The *Second Report on the Implementation of Integrated Water Resources Management in the Arab Region*, which will be produced under the framework of SDG indicator 6.5.1 reporting in cooperation with the United Nations Environment Programme (UNEP), will include a section on groundwater as a regional priority. This will draw upon country responses related to groundwater to identify regional groundwater challenges and opportunities within IWRM;

(c) The *2021 Arab Regional Report on Transboundary Water Cooperation*, which will be produced under the framework of SDG indicator 6.5.2 reporting in cooperation with the United Nations Economic Commission for Europe (ECE) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), will include a focus on transboundary groundwater. This will draw upon country responses related to transboundary groundwater and cooperation arrangements to identify regional challenges and opportunities;

(d) The theme of the World Water Day for 2022 will be “Groundwater: making the invisible visible”. ESCWA is also contributing to the 2022 World Water Development Report under the same theme with a section on groundwater in the Arab region. ESCWA is also a member of the UN-Water task force that is organizing the World Water Day campaign and the Groundwater Summit to be held in December 2022 in Paris. ESCWA will work with member States to ensure that regional priorities and key messages are reflected in these and other global water forums. Regional dialogues on groundwater will be also streamlined with ongoing regional dialogues in preparation for the Midterm Comprehensive Review of the Water Action Decade and other regional processes;

(e) ESCWA will launch in 2022 a United Nations Development Project for Improved Water Security in Arab States. This project aims to increase access to regional knowledge and information on groundwater resources through a dedicated digital interactive platform. The project aims to also build capacities on access to disruptive technologies for improving knowledge on groundwater and on assessing the impacts of climate change on groundwater through training and case studies identified on a demand-driven basis. The project thus aims to empower those responsible for water resources management in ESCWA member States and regional stakeholders through capacity-building activities, tailored technical assistance and access to information on groundwater through a digital knowledge platform that complements other regional knowledge platforms and networks that ESCWA has built on climate change, integrated water resource management and the SDGs. Member States are requested to nominate national focal points to support activities of this project and are encouraged to join the governance board of the digital platform and engage with ESCWA in requesting the application of pilot case studies in their countries. Other resources and partnerships are also being forged to enhance these efforts.

### **B. Proposals for future work**

26. ESCWA invites the Committee on Water Resources to advise on further areas of work that it would like the secretariat to pursue on groundwater resources management. Specifically, the Committee is invited to advise how it would like the secretariat to pursue the governance structure of the groundwater dedicated digital platform, the regional and global dialogues on groundwater as part of the World Water Day theme activities and the technical assistance or capacity-building support on groundwater resources management for ESCWA member States.

-----