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# Water, Growth and Stability

## Background document for the REC's World Café 2016 at WWW2016

R. Laušević • V. Vassilev
A. Kis • F. Abdulla • S. Milutinović

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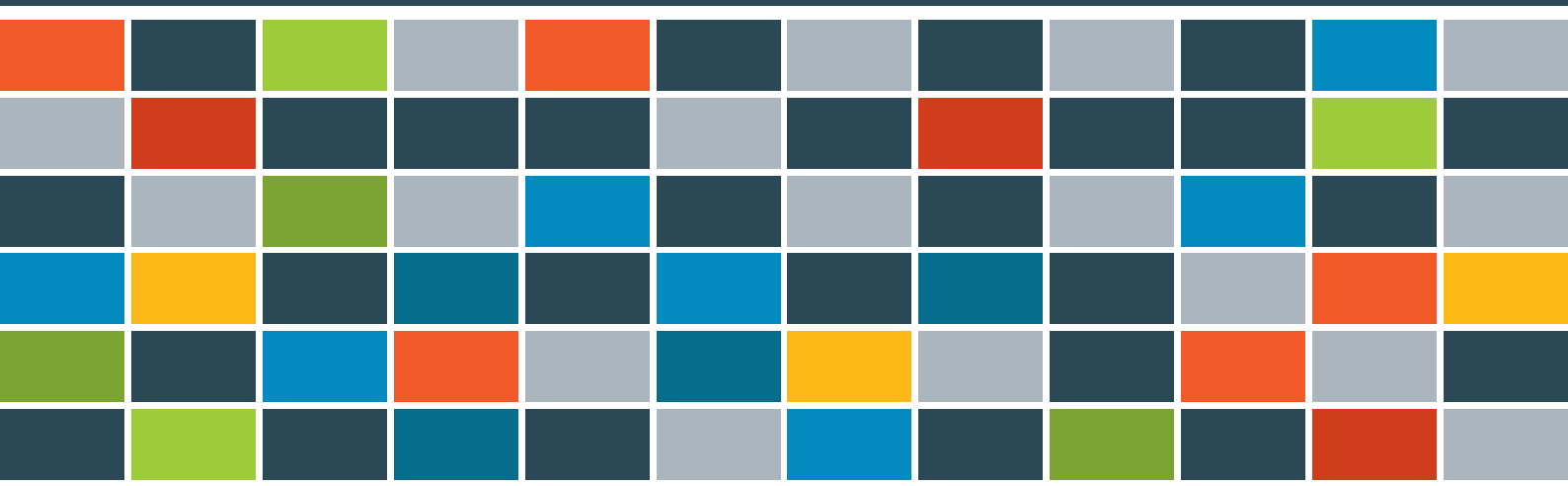

The World Café at World Water Week 2016 brings together representatives of central and local governments, regional bodies, NGOs, academia and businesses from the region for lively discussions in a pleasant atmosphere, following up on the Middle East and North Africa (MENA) Focus opening session themes. Participants at the event divided into three working groups. The present background document comprises three articles prepared by experts to address the topics of the three working groups: Governing water for sustainable growth (Group 1); Water-related climate change mitigation and adaptation measures for sustainable growth (Group 2); and Water security action planning for sustainable growth (Group 3).

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Regional Environmental Center
Szentendre • Hungary

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# Contents

# Water, Growth and Stability

Background document for the REC's World Café 2016 at WWW2016

## Introduction

In response to the rapid depletion of water resources, deterioration in water quality, increased water demand, and changes in water endowments that are affecting environmental quality, food security, municipal infrastructure and economic development in most societies in the Middle East and North Africa (MENA), the Regional Environmental Center (REC, www.rec.org) is implementing the project "Sustainable Use of Transboundary Water Resources and Water Security Management" (WATER SUM) (www.watersum.rec.org). The project is funded by the Government of Sweden (Swedish International Development Cooperation Agency [Sida], contribution ID 52030234) and is being implemented between April 2014 and April 2017.

The overall objective of the project is to promote and enhance sustainable water resources management and to foster a comprehensive and integrated approach to water security and ecosystem services for sustainable development in beneficiary countries in the MENA region in order to help halt the downward spiral of poverty, biodiversity loss and environmental degradation.

The project is divided into two components: "Water Resources Management Good Practices and Knowledge Transfer" (Water POrT); and "Water and Security" (WaSe). The goal of the Water POrT component is to accelerate the more sustainable use of the region's water resources and to promote a strategic approach to climate change adaptation. The WaSe component aims to foster a comprehensive and integrated approach to water security and ecosystem services for sustainable development in eight selected administrative territories in Jordan and Tunisia. The WaSe component is a part of efforts to combat water scarcity and increase overall human well-being within the wider context of ensuring regional peace and stability.

Two main results are envisaged:

- Increased capacities on the part of the respective national authorities to apply an integrated water resources management (IWRM) approach; a framework for common understanding promoted among water practitioners and stakeholders regarding the need for cooperation and a regional approach to managing water problems; and strengthened abilities among practitioners for dealing with the impacts of climate change on the region's water resources (WATER POrT component).
- The process of introducing and drafting local water security action plans (LWSAPs) initiated and supported in target administrative territories in Jordan and Tunisia, while partner communities work jointly towards sustainable development; and local environmental governance in partner countries benefiting from the LWSAP concept (WaSe component).

One of the major outputs of the WATER SUM project is the **Water, Growth and Stability Initiative (WGSIni)**, a framework for the creation of a knowledge-based platform; a dynamic network of water experts; and an e-learning tool for capacity building and the dissemination of lessons learned. The WGSIni was launched in April 2016 as an output of the multi-stakeholder conference "Water, Growth and Stability: Transboundary Water Cooperation for Sustainable Growth and Stability in Middle East and North Africa (MENA)" under the framework of the WATER SUM project.

The WGSIni contributes to the MENA Focus component of World Water Week 2016 by exploring solutions to the water crisis in the MENA region, promoting water governance for sustainable growth,

raising awareness of the SDGs through the Arab MDG+ Initiative, and organising the event "MENA Focus: World Café 2016/Water, Growth, Stability" (http://wgsini.rec.org/worldwaterweek2016).

The World Café 2016 at WWW2016 brings together representatives of central and local governments, regional bodies, NGOs, academia and businesses from the region for lively discussions in a pleasant atmosphere, closely echoing and following up on the MENA Focus opening session themes. Using a modified World Café Method (www.theworldcafe.com/method.html), this event (http://programme.worldwaterweek.org/event/6008) will kick off with a brief plenary session, during which discussion topics will be outlined and participants divided into three working groups.

The present background document comprises three articles prepared by experts and addressing the topics of the three working groups: Governing water for sustainable growth (Group 1); Water-related climate change mitigation and adaptation measures for sustainable growth (Group 2); and Water security action planning for sustainable growth (Group 3). The event will bring together leaders representing central and local governments, regional bodies, NGOs, academia and businesses from the region. The working groups will rotate at intervals of 25, 20 and 15 minutes, while facilitators will remain in the respective area during the entire process and later support the summary of outcomes. Expected discussion outputs are: how MENA countries can contribute to the implementation of the water-related SDGs and the new climate agreement; how MENA countries can address cross-cutting issues including migration, gender, youth and human rights; and how water-related security issues can be addressed most efficiently.

# 1. Governing Water for Sustainable Growth

MENA Water World Café 2016 Background Paper, Working Group 1

***Ventzislav Vassilev, Regional Environmental Center (REC)***
***András Kis, Regionális Energiagazdasági Kutatóközpont (REKK)***

## Introduction

The Middle East and North Africa (MENA) region, stretching eastwards from Morocco across northern Africa to the Persian Gulf, and from Turkey in the north to Yemen and Oman, is facing the overarching water-related problem of water quantity: Water is a scarce resource. However, water quality is also emerging as an important issue and is of growing concern to the public. Besides posing threats of its own, climate change will act as a multiplier of already existing stresses and further affect water availability and quality. Key characteristic features in the region are that water resources are often shared between two or more nations, and there is heavy reliance on groundwater resources.

Water policy and water availability are considered central determinants of the future well-being of the region. Cooperation with respect to regional/transboundary water resources is politically sensitive and closely connected to ongoing conflicts in the region. On a technical level, there are various ongoing cooperation initiatives that can stimulate political rapprochement. The capacity of countries to manage the region's water resources more efficiently by using the integrated water resources management (IWRM) approach is a decisive factor for future development. Greater regional cooperation and dialogue on water issues can influence national water management, and vice versa, and can help to bring peaceful development to the region.

Despite conditions of water scarcity and the dramatic shrinkage of natural freshwater resources per capita in recent decades, MENA countries have made progress in providing improved water and sanitation to their populations. Numerous investment projects have significantly improved access to water and sanitation in urban areas. Access is at nearly universal levels in Jordan, Lebanon, Morocco and Tunisia, and at a high level in Egypt, Algeria, Libya and Syria (Milutinovic 2015). At the same time, the recent political instabilities and conflicts in some countries have resulted in serious water management challenges, such as the collapse of water supply operations in conflict areas, and a big influx of refugees to neighbouring countries.

## Water governance perspectives in the MENA region

Water governance is defined by the political, social, economic and administrative systems that are in place, and which directly or indirectly affect the use, development and management of water resources and the delivery of water services at different levels of society. Importantly, the water sector is part of broader social, political and economic developments and is thus also affected by outside decisions (UNDP, SIWI 2013). Good water governance should ensure a mix of policies, principles and tools such as water diplomacy; regional, transboundary and cross-border cooperation; integrated river basin planning and management; climate adaptation; public participation; accountability; transparency; subsidiarity; and appropriate decentralisation.

Water governance issues in the MENA region are varied, but generally shared by countries in the region. The key issues can be grouped as follows: insufficient institutional skills in applying the IWRM approach and in adaptation to climate change; insufficient understanding of how policy instruments for water management can affect the economy and growth; limited application of a holistic approach in water policies, multi-sectoral involvement and the coordination of roles and responsibilities; social sensitivity regarding water allocation between economic sectors; hesitant transboundary cooperation

for promoting the sustainable and equitable development of a shared watercourse; and unsatisfactory cooperation, joint research actions and knowledge sharing.

To overcome these challenges, many countries are in the process of restructuring the institutions involved in water and environmental governance, introducing stakeholder involvement practices, and decentralising the water sector. In recent years, significant progress has been made in the region in terms of improved regional/transboundary cooperation.

The importance of IWRM for promoting coordination, consolidation and integration in the region was highlighted among the conclusions of the third Arab Water Forum. Integration in particular should involve all sectors relying on water and ensure stronger stakeholder engagement and communication as well as enhanced water use efficiency methods in irrigation and financing policies at national scale.

## Sustainable development goal on water and sanitation

According to the official Millennium Development Goals Report published in 2014, Target 7C to halve the proportion of people without access to an improved drinking water source has been achieved. Notwithstanding the importance of achieving the overall target, significant regional disparities and stark variations between urban and rural areas, as well as the large number of people still relying on unsafe water sources, are evidence of the need to ensure that additional actions be directed towards those untouched by ameliorations to date. However, the target of improving basic sanitation, including access to latrines and hygienic waste collection, is not on track and requires sounder commitment in order to be recalibrated and hopefully met in the coming years.

The Sustainable Development Goals (SDGs), adopted at the United Nations Sustainable Development Summit on September 25, 2015, build on the experience and lessons learned from the earlier MDGs. Sustainable Development Goal 6: “Clean water and sanitation” contains the following targets:

- By 2030, achieve universal and equitable access to safe and affordable drinking water for all.
- By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
- By 2030, improve water quality by reducing pollution, eliminating dumping and minimising the release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.
- By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
- By 2030, implement IWRM at all levels, including through transboundary cooperation as appropriate.
- By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.
- By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.
- Support and strengthen the participation of local communities in improving water and sanitation management.

Water is a key aspect of many of the 17 SDGs (1, 3, 4, 11, 12, 14 and 15 contain an explicit reference to water; and 2, 5, 7, 8, 9, 10 and 13 contain an implicit reference to water), since water forms the

basis of life on earth, is vital for socioeconomic development, is essential for biodiversity, and is a fundamental human right.

The MENA region is at the forefront of the multiple, mostly noxious, effects and impacts deriving from water-related issues. Sustainable Development Goal 6 encompasses several provisions that, if ultimately approved, may assist in boosting the region's development and resilience.

## Legal and institutional aspects of IWRM

The administrative structures and legislation for water governance vary from country to country and there is no common water governance model for the region. To encourage better management and conservation, many countries have shared responsibilities for water management between several ministries, while engaging water stakeholders at various levels of governance. Consequently, improving relationships between competent authorities and stakeholders at all levels of governance, strengthening democracy and combating poverty remain high-priority issues in the region.

In **Jordan**, three government agencies are involved in the management of the water sector: the Ministry of Water and Irrigation (MoWI), with the Water Authority of Jordan (WAJ) and the Jordan Valley Authority (JVA) under its umbrella. The two authorities are headed by secretaries general, who report to the minister of water and irrigation. In addition, the Ministry of Environment (MoE) was established in 2003, and has a technical division on water quality. An overall vision and strategy for water and environment structures for regional cooperation is largely in place. The Water Strategy, formally adopted in May 1997, takes an integrated approach to water management and gives high priority to the resource value of reclaimed water. A new strategy, "Water for Life", covers the period 2008–2022. The National Water Master Plan, adopted in 2004, analyses future water-use demand and assesses consolidated supply measures against future demand needs.

In **Tunisia**, most of the tasks related to water management fall under the Ministry of Agriculture and Hydraulic Resources, and within this there are various departments (more than 10 general directorates and other organisations) dealing with water exploitation for different purposes, conservation, the management of dams, and research and development. In 2003, the Ministry of Agriculture and Hydraulic Resources published the Water Master Plan for the water sector. Two main strategic options were identified and implemented: a 10-year strategy for water resources mobilisation (2001–2011), initiated for the first time in 1990; and a long-term strategy (to 2030). A practical drought guidance document was elaborated in 1999 with the aim of informing different user groups and institutions about appropriate measures for impact alleviation and mitigation. The Water Code (1975) sets out provisions on water quality, and is reinforced by Law No. 95-73 of July 24, 1995, on the Public Maritime Domain; and Law No. 95-70 of July 17, 1995, on Water and Soil Conservation.

In **Egypt**, the Ministry of Water Resources and Irrigation (MoWRI) is mandated to achieve the optimal use of water while meeting the needs of all sectors in terms of both quantity and quality. Technical advice is provided to the ministry by the National Water Research Centre. The Ministry of Agriculture and Land Reclamation (MoALR) develops the overall policies for agriculture (including aquaculture) and land reclamation. The Ministry of State for Environmental Affairs is mandated to formulate environmental policy and the necessary plans for the protection of the environment. The Ministry of Housing, Utilities and Urban Communities (MHUUC) covers the whole sector of drinking water and wastewater. Several sectoral laws and decrees govern water in three main sectors: water resources; environment; and water protection, wastewater management and wastewater reuse. The Government of Egypt has introduced legislation to protect the quality of freshwater. Law 27/1978 regulates water resources and the treatment of water. Environmental Law No. 4/1994 protects the environment in Egypt in general, while Law No. 48/1982 and Decree 8/1993, amended by Law No.

9/2009, deal with the pollution of all water sources in Egypt and sets standards for the discharge of liquid waste to freshwater. Specific laws on irrigation (Law No. 12/1984 and Law No. 213/1994) define the use and management of public and private sector irrigation and drainage systems.

In **Morocco**, the Secretariat of Water and the Environment is the main institution responsible for water management. Among its responsibilities are water resources assessment, monitoring, transfer, management, security, capacity building, and research and development. The National Meteorological Directorate is responsible for the elaboration and implementation of government policy for water resources planning, mobilisation, management and preservation, and the management and maintenance of large hydraulic infrastructure. Other departments are in charge of providing information and technical assistance in the area of meteorology for the hydraulics, agriculture, aeronautics and maritime sectors. Hydrological basin agencies were created by the Water Law (1995) for each of the nine main river catchments in the country. These public organisations are in charge of water resources management in each basin and their tasks and responsibilities include the proper implementation of water management plans; the enforcement of water rights; the provision of financial and technological assistance to private operators; water monitoring; and studies on water resources protection and flood control.

## Regional cooperation initiatives on water issues

A number of initiatives and organisations have been established to promote regional cooperation, transfer know-how, and ensure political support for the improvement of water governance.

The **Arab Water Council**, established in 2004 as a non-profit regional organisation, promotes the water agenda in the MENA region.

The **Global Water Partnership Mediterranean (GWP-Med)**, established in 2002, is the Mediterranean branch of the Global Water Partnership (GWP). Aiming for a water-secure Mediterranean, GWP-Med promotes action, demo application and knowledge exchange on IWRM, and the sustainable use of water resources in the region.

The **Union for the Mediterranean**, a multilateral partnership aiming to increase the potential for regional integration and cohesion among Euro-Mediterranean countries, promotes a specific water agenda designed around the four pillars of water governance, water and climate change adaptation, water demand management and water financing.

The **Arab Ministerial Council for Water**, established in 2008 within the League of Arab States, adopted the Strategy for Water Security in the Arab Region in 2010. The strategy, focusing on the run-up to 2030, identifies regional priority actions to ensure water security across the region centred on the principles of IWRM.

The **Organisation of Islamic Cooperation (OIC)** embraced the OIC Water Vision in 2012. This comprehensive document provides a framework for promoting cooperation for a water-secure future through increased interaction, the exchange of best practices, knowledge sharing, capacity building and the development of expertise in various water-related disciplines. The OIC also supports research and capacity-building programmes centred on regional water issues through its subsidiary organ, the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC).

The **Regional Office for West Asia of the United Nations Environment Programme (UNEP/ROWA)** and the United Nations Economic and Social Commission for Western Asia (UN-ESCWA) contribute to raising awareness and enhancing response capacities regionally through studies, capacity-building activities and trainings focusing on climate change and shared IWRM.

The **Organisation for Economic Co-operation and Development (OECD)** is also actively contributing to water-related matters across the MENA region through its MENA-OECD Governance Programme and its Programme on Water Governance.

The **Water, Growth and Stability Initiative (WGSIni)** was launched at the first Water, Growth and Stability conference, which took place on April 26–28, 2016, in Szentendre, Hungary, co-organised by the Regional Environmental Center (REC) and the Ministry of Foreign Affairs and Trade of Hungary as a pre-event to the Budapest Water Summit 2016.

## Stakeholder involvement in water governance

Participatory processes support a high-quality, more informed decision-making process, as decisions reflect the views and responses of stakeholders. The participation of stakeholders can help to legitimise decisions, and to resolve conflicts and build trust among water users. Participatory approaches are also helpful in informing policy makers about relevant feedback from stakeholders who will be affected by decisions (Kessler 2004).

Stakeholders' interests may be environmental, economic, social, cultural, recreational, religious, geographical or other, and may be either legally or otherwise defined. In the broader sense, stakeholders may be additionally defined as those having some influence on the outcome of the decision making, or some expertise, knowledge, experience, information or activities that may be useful in the decision-making process.

The main categories of stakeholders are: 1. public authorities and agencies; 2. water user associations and cooperatives; 3. civil society; 4. the private sector; 5. the scientific and research community; and 6. international organisations, donors and networks.

The leading role of **national water authorities** (ministries and state agencies) in the development and enforcement of water policies is common to all MENA countries. Water supply and sanitation services are predominantly state owned and operated. The involvement of the private sector is still limited, although according to the water sector strategies of several countries there are plans to increase its role.

**Water user associations** (or irrigation cooperatives) are cooperative bodies that are responsible for the maintenance of the water supply and irrigation infrastructure in rural areas. Such associations are common in many Arab countries and are based on traditional practices.

The role of **civil society organisations** (CSOs, NGOs) in the environmental domain has increased in recent years as a result of the democratic transformations. In most cases, however, CSOs do not have adequate technical capacity and knowledge to be equally present in the formulation of national water policies.

**The private sector** is expected to play an increased role in water management with the privatisation of water services, the introduction of new public-private business models, and the increased valorisation of water uses.

**Scientific and research organisations** in the region are particularly important for both local R&D and the adaptation of best available technologies to the regional and country-specific conditions.

**International organisations, donors and networks** provide the environment for regional dialogue, capacity building and knowledge transfer.

## Summary of water management issues

Water management is a complex topic that includes, for example, the planning, development, distribution and management of water uses; the development of policies and regulations; and the protection of the quality and quantity of water resources. Based on the review of strategic and planning documents for the water sector in various MENA countries, the main water management issues can be grouped according to the categories outlined below.

### Water demand management

Given the general scarcity of water in the region, water demand management and water conservation play a crucial role in achieving the sustainable use of freshwater resources. Demand management aims at the efficient utilisation and minimum waste of water, and at the promotion of water conservation at water user level in order to bridge the gap between supply and demand and advance economic growth and social development. Water demand challenges are enormous, especially in regions with unexpected population growth due to conflicts and political instability.

Water is an essential input to most economic activities (especially agriculture, but also many industries such as energy generation, the food industry and manufacturing), and it is also the foundation of the well-being of the population. Expanding the supply of water has natural as well as economic limitations: there is a finite — and in many locations declining — volume of water available to the countries of the MENA region. Decision makers often face the uncomfortable question of how to allocate a limited volume of water among a growing number of water consumers.

There are some answers that are attractive in principle but difficult to implement in practice. The first challenges facing policy makers within the MENA region are to ensure sufficient water to satisfy the basic needs of households; provide additional water to cities at an increasing block rate in order to give incentives to save water; and, with respect to economic activities, allocate water for the most economic uses — that is, to economic activities that generate the most output per cubic metre of water used.

This vision makes sense, but it poses a big challenge in terms of implementation. First, the basic needs of the population should be defined: very simply, what is the minimum amount of water to be supplied to each household at an affordable rate? What about households of different sizes? Do we have such information, and can we tailor the tariff system to be compatible with household size? Once basic needs are satisfied, which tariff level should be applied for further consumption?

After questions related to water supply to households have been resolved in a satisfactory manner, an even more difficult question arises: On what basis, and how, should water be reallocated towards the most economically productive uses? There are no readily available figures on the value of water in an economic activity, thus the authorities making water allocation choices do not have a good basis for making such decisions. It is possible to create mechanisms that reveal the value of water for different sectors (such as auctions, water markets, or observing the reactions of water users to different levels of water tariffs), but how acceptable are these instruments in a given society? And even if policy makers are certain that they are making a justified reallocation of water to a more economic use, the position of the producers in some sectors will be severely hurt, jobs will be relocated, and for some people their way of life will change as a result of adaptation. Are these actors to be compensated? In what form and to what degree?

The rationale of water reallocation should also consider other factors such as food security and rural employment, migration, and distinguishing between different subsectors within agriculture. In this regard, smart policies need to be developed to make transition a smooth and gradual process:

providing time, resources and information to water users to achieve a new level of water saving, while making sure that there are incentives in other sectors to use the reallocated water in an efficient way.

### Mobilisation of water resources and water supply

A growing population and economic development in the countries of the MENA region is resulting in increased demand and the need to mobilise to the maximum natural freshwater. Many strategies and measures have been implemented in order to alleviate and overcome water shortage, including the construction of large and small dams, wells, canals and other hydraulic structures. In some countries (e.g. Tunisia), the mobilisation of available water resources exceeds 90 percent. Groundwater is being exploited at a rate that exceeds the recharge rate, which creates a serious risk to water supply in the future. Long-distance water conveyance and the use of non-conventional resources are alternative ways to increase water supply, but at far higher financial and environmental cost.

### Preservation and protection of water resources

Although water scarcity is the main problem in the region, water quality has also become an issue of concern in recent years. Industrial, urban and agricultural pollution, combined with a decline in natural ecosystems and the impacts of climate change, have resulted in a global trend towards the deterioration of water quality. Quantity and quality issues are also greatly interconnected. The abstraction of water from surface water and groundwater bodies, for example, increases the concentration of pollutants and salinity, and damage to natural water ecosystems reduces their self-purification capacity.

### Natural hazards associated with floods and droughts

Natural disasters, accelerated by climate change, are difficult to predict and result in increasing social, economic and environmental impacts. In spite of the traditional knowledge of people living in arid regions, unpredicted long periods of drought may cause devastating water shortages for the population, agriculture and industry. Although floods are not common in the region, the recent torrential floods in Morocco and Tunisia, and local cases in Jordan, show that greater attention and a more integrated approach are needed with respect to this natural phenomenon.

Prevention and response measures may include monitoring and forecast systems, structural measures, the development of emergency plans, and financial mechanisms such as insurance and natural disaster funds.

### Regulatory and institutional reforms

Institutional and regulatory frameworks are the subject of revision and improvement in a number of countries, as stipulated in their recent water strategies. The present structure of the water sector in most MENA counties is characterised by a predominantly administrative approach, with the distribution of responsibilities between several ministries or agencies and sometimes difficulties in coordination. The need for new business models with private sector participation is clearly recognised.

### Modernisation of information systems and monitoring networks

Significant steps towards the development of national water information systems have been made in many countries, and the rapid introduction of contemporary IT solutions has been notable in the last decade. However, access to information and the exchange and consolidation of data between responsible institutions in one country, and between neighbouring countries, are often missing.

Existing monitoring systems are focused on water quantity and basic quality parameters, but there is insufficient capacity to introduce the comprehensive monitoring of the ecological status of waters.

### Capacity building

State institutions, organisations and individuals have various roles in water management that require specific technical and administrative capacities. Insufficient institutional skills in applying the IWRM approach and adaptation to climate change have been identified in various studies and strategic documents.

There are a number of isolated capacity-building projects and initiatives, but the need for consolidated knowledge management at regional level has not so far been met. The transfer of knowledge and experiences between countries is of great importance, due to the applicability of best practices in similar conditions.

### Research and development

Universities and research institutes play an important role in assessing the status of water resources, and in technical and non-technical innovations and solutions. Water research and the transfer of technologies between different regions are significantly accelerated with the support of international cooperation initiatives. However, the encouragement and enhancement of indigenous water research is equally important because of the specific local and regional conditions, where “imported” solutions are ineffective or require adaptation.

### Regional cooperation

Most of the river basins and groundwater bodies are shared between two or more countries, which results in the dependence of downstream countries on upstream ones in the case of surface waters, and mutual dependence in the case of groundwater use. Despite the existing regional initiatives, cooperation is often merely formal and needs further improvement in terms of actual communication and dialogue.

## Knowledge development and capacity building

Water management practices in MENA countries have a long history of development in a context of extremely scarce water resources. Traditional knowledge has lately been enriched by international experience gained in the course of various projects.

A number of recent studies, including interviews with national stakeholders in Jordan, Tunisia, Egypt and Morocco, carried out in the framework of the WATER SUM project, have identified an essential need for capacity building on important issues related to water management.

### Knowledge and practices related to water demand management

Although the MENA region has made significant progress towards the protection and efficient use of freshwater and irrigation water in recent decades, there are still uncertainties and gaps in analysing the social and economic driving forces of water demand. The building of capacities to perform sound social and economic analyses was identified as a need.

The management of water demand at local level (mainly irrigation) requires an improvement in the capacities of water user associations. Decentralisation and privatisation, as well as support to the retailing of water by user associations, are included in numerous national strategies and plans, including the Water Strategy of Jordan “Water for Life” 2008–2022, the Tunisian Long-Term Water Strategy, and the National Water Strategy 2009–2030 of Morocco. In all these countries, the water strategies identify gaps in the human and technical capacities of water user associations, which hinder their communication with the state water authorities.

### Technology transfer for the mobilisation of water resources

In recent decades, water sector policies and investments in the MENA region have focused on mobilising water resources. Countries have reached a very high level of mobilisation of existing natural freshwater resources, in some cases exceeding the carrying capacity of surface water bodies and non-renewable groundwater. The focus is therefore now on research, innovation and technology transfer related to non-conventional water resources.

Best practices on atmospheric precipitation and water harvesting must be promoted at all levels in order to improve the efficiency of these methods, particularly in rural areas. This may include the exchange of best practices and trainings on methods and technologies for improving the efficiency of water harvesting.

### Research and data for water resources protection

Numerous studies have been undertaken that provide hydrological information and other data related to different aspects of water management in MENA countries. However, the data are often scattered, and exchange protocols and mechanisms are missing at national and regional levels. The need for improved data management approaches has been outlined by stakeholders in Jordan and Tunisia, including software development, and more and better data are required for proper analyses and assessments in the context of future decision making by responsible institutions.

The monitoring of water quality varies among MENA countries and normally focuses on basic physical and chemical parameters with universal use. The introduction of biological monitoring and integrated water quality classification will require additional training, as experience in the countries is currently limited.

### Increased capacity on socio-political aspects of IWRM

It is considered an appropriate time to further facilitate the involvement of stakeholders in decision-making processes, and to encourage public participation by raising awareness of the importance of each individual's contribution to sustainable water resources management. Awareness raising should improve knowledge at household level.

Civil society and local governments should be concerned about appropriate sources and uses of water. They can support water management and can have a huge, positive effect in terms of pollution prevention, for example. However, the effective participation of stakeholders in decision-making processes requires improved technical skills and competencies on the part of CSOs and local authorities.

### Research and data management on climate change impacts

A need for improved climate and hydrological data management has been identified, including extreme events such as droughts and flash floods. This includes different phases of the data management cycle and various approaches such as processing and analyses, interpretation, software, modelling, monitoring and quality assurance.

The use of non-conventional water resources is considered an important direction in order to increase water supply and as a climate change adaptation measure. However, further knowledge and analysis are necessary regarding the environmental impacts and socioeconomic costs of non-conventional water resources (e.g. desalination).

# 2. Water-Related Climate Change Mitigation and Adaptation Measures for Sustainable Growth

MENA Water World Café 2016 Background Paper, Working Group 2

***Prof. Fayez Abdulla, Jordan University of Science and Technology***

## Introduction

Climate change refers to an alteration in the state of the climate that can be identified by changes in mean values and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity (IPCC 2007a). Scientists have established a causal effect between the acceleration of greenhouse gas (GHG) emissions and climate change impacts (IPCC 2007a). Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70 percent between 1970 and 2004.

Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC) refers to preventing dangerous human interference with the climate system, in a timeframe sufficient to allow ecosystems to adapt naturally, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner. Global, national and local measures are needed to combat the adverse impacts of climate change. In its most recent report, the Intergovernmental Panel on Climate Change (IPCC) concludes that "water and its availability and quality will be the main pressures on, and issues for, societies and the environment under climate change" (Bates et al. 2008). Over the past decade, evidence of global warming and the accompanying changes to the Earth has mounted. The IPCC's fourth assessment report concludes that it is 90 to 99 percent likely that the rise in global atmospheric temperature since the mid-19th century has been caused by human activities (IPCC 2007a).

It is a well-established fact that the temporal and spatial variability of freshwater resources is very sensitive to changes that may occur in the climate mechanism due to global warming. It is assumed that the frequency of extreme hydrological events (floods and droughts) will increase as a function of various climate change scenarios (Abdulla et al. 2009). Hydrometeorological hazards such as floods and droughts affect many regions of the world, but their impact in terms of lives lost and livelihoods disrupted tends to fall most heavily on the poor in developing countries. Climate change threatens to heighten these impacts in many areas, both by changing the frequency and/or intensity of extreme events and by bringing about changes in mean conditions that may alter the underlying vulnerability of populations to hazards. The result in the decades to come may be an increase in the global burden of weather-related disasters: events that can threaten the sustainability of development processes and undermine progress towards poverty reduction.

Most Arab countries are located in arid and semi-arid zones, characterised by scanty annual rainfall, very high rates of evaporation, and consequently extremely insufficient renewable water resources. The sustainable management of water resources is vital, as water scarcity is becoming more and more of a development constraint, impeding the economic growth of many countries in the region. Due to the expanding population this century, together with increasing per capita water demand and the huge socioeconomic developments over the last three decades, the need for the sustainable use and integrated management of the region's scarce water resources has become a key condition for survival. Many of the surface water and groundwater resources in the region are drawn from shared rivers and aquifers respectively, which further complicates the situation. The consequences of water scarcity and

conflicts could lead to serious crises and possible confrontations, if they are not looked at and dealt with using a mandatory, equitable and sustainable approach.

For the Arab region, future projections using climate models point to an increase in temperature and a decrease in rainfall. Both present variability, while long-term climate change impacts are most severe in the developing world, which is least able to buffer itself against them. Climate change impacts are particularly severe in countries, regions and communities where the capacity to cope with, and adapt to, the hydrological effects of climate variability will influence their overall development prospects.

Climate-related impacts on water resources are already being documented. Global climate models predict a warmer planet. For the Arab region, the possible changes to the climate— specifically temperature, evaporation, rainfall and drought —are also likely to affect the availability of water resources and will influence plans to meet expected demand for water in the future. In the case of surface water resources, the connection between climate and water availability is clearer and more immediate, although it does have its complications, such as changing land use associated with climate change.

The implications of climate variability and climate change have not fully been taken into account in the current decision-making framework. An assessment of vulnerability and consequent risks to water resources due to climate change impacts is therefore necessary in order to work out appropriate adaptation and mitigation responses. The overall purpose of this study is to give a general overview of the studied impacts of projected climatic changes in the Arab region, in order to address some key points related to adaptation and mitigation planning.

This paper attempts to shed light on climate change and climate variability as phenomena that might affect water availability in the Arab region, and on how vulnerable Arab countries can mitigate and adapt to their positive and negative impacts. The paper explores the risks to the Arab region from the impacts of climate change over the next 30 to 50 years. For this purpose, the vulnerability of water resources to climate change in some Arab countries was reviewed and presented. Adaptation measures were then suggested, along with current policies and their implications for the vulnerability of different sectors. The proposed adaptation measures can be included as projects within each national action plan for climate change. The proposed projects have many cross-cutting issues with other sectors and will therefore be compiled with similar projects under the same programmes. Adaptation policies should be implemented in order to enhance and facilitate actions that will reduce Arab countries' vulnerability and improve their resilience to climate change. For adaptation measures to be successful, leadership is required to inspire confidence and agreement among all levels of government, the private sector and civil society.

## Arab countries' contribution to GHG emissions

There is a widely held scientific conviction that the global climate is changing as a result of combined anthropogenic forcing due to greenhouse gases (GHGs), aerosols and land surface changes. Based on many pieces of evidence, it has been concluded with a high degree of probability that human activities have exerted a substantial net warming influence on the climate since 1750 (IPCC 2007c). Physical and biological ecosystems on all continents and in most oceans have already been affected by recent climate changes (IPCC 2007b). It is now generally accepted that these changes are the result of increasing concentrations of carbon dioxide, methane, nitrous oxide and other GHGs in the atmosphere (IPCC 2001b).

For the year 2000, statistics show that the world's total GHG emissions from all sources was about 33,000teragrams (Tg), with Arab countries contributing about 4.2 percent of the total world emissions

(WRI 2005). As presented in Figure 1, the Kingdom of Saudi Arabia is contributing the highest percentage of total GHG emissions from among Arab countries, followed by Egypt and Algeria (WRI 2005). This relatively small contribution of GHGs from all Arab countries does not correspond to the projected impacts of climate change over the region (AFED 2008). Despite the fact that the Arab region has historically made the smallest contribution to global warming, scientific projections indicate with a high degree of confidence that it will be disproportionately affected by climate change (AFED 2008). As of 2004, the total share of the United Nations Economic and Social Commission for Western Asia (ESCWA) region was limited to 3 to 4 percent of global emissions. Water in the ESCWA region is central to both climate change and human development, and most of the impacts of climate change will hit the region through its scarce water resources.

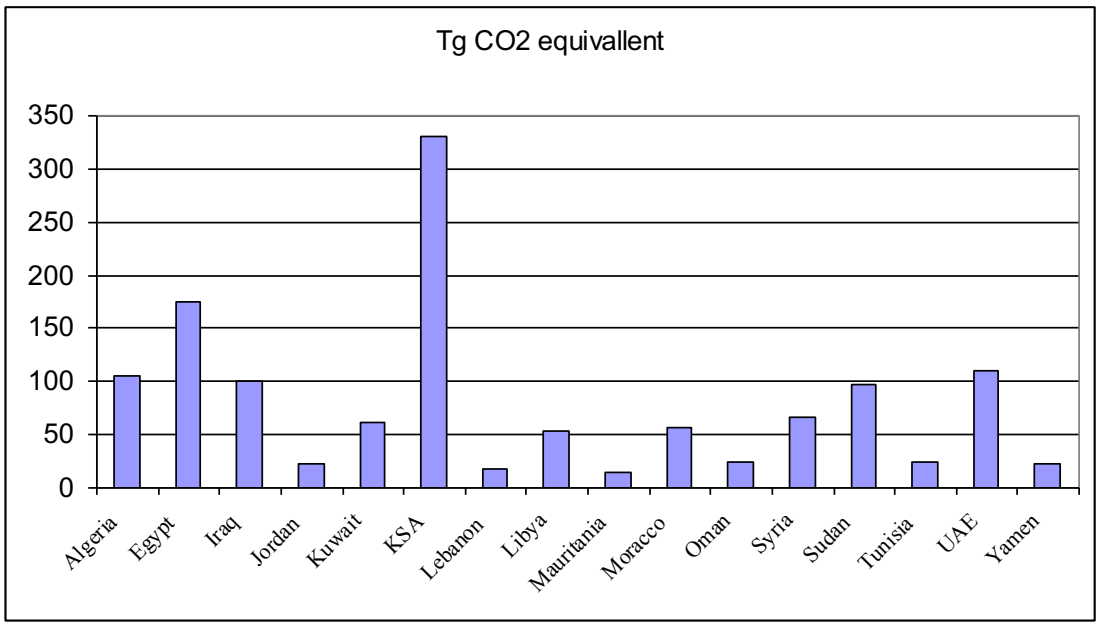


Figure 1: GHG emissions in the year 2000 from Arab countries (WRI 2005)

## Climate trends in the wadi systems in the Arab region

The Arab region stretches from Morocco and Mauritania in the west, through northern Africa and the Levant, to the Arabian Gulf in the east (Figure 2). Accordingly, Arab countries can be divided from a hydrological point of view, into the following subdivisions:

- Al Mashrek countries: Iraq, Syria, Lebanon, Jordan and the Palestinian territories.
- Al Maghreb countries: Libya, Tunisia, Algeria, Mauritania and Morocco.
- Nile Basin countries: Egypt and Sudan.
- Arabian Peninsula: Saudi Arabia, Kuwait, United Arab Emirates, Qatar, Oman, Bahrain and Yemen.
- Sahel countries: Somalia, Djibouti and Comoros Islands.

Each of the above five regions has distinct hydrological characteristics. This division will be followed in different sections of this study.

The Al Mashrek region comprises three major basins: the Jordan River Basin (Jordan, Lebanon, the Palestinian territories and Syria), the Euphrates River Basin and the Tigris River Basin. The Euphrates

has a surface area of 450,000 km$^2$ and is 2,735 km long. It rises in Turkey and flows through Syria before entering Iraq on its way to the sea, where it joins the Tigris to form the Shatt al-Arab. The Tigris Basin is shared by Syria, Iraq and Turkey, with Iran in addition. The basin covers about 110,000 km$^2$ and the river is about 1,900 km long. Before the confluence of the Euphrates and the Tigris, the two rivers flow through Iraq for about 1,000 km and 1,300 km respectively (SIWI 2009).


Figure 2: Arab countries

A key water source in the region is the Jordan River system (JRS). The JRS comprises several hydrological units. The Upper Jordan is fed primarily by the Dan, the Hasbani, and the Banias streams that combine to become the Upper Jordan River. The Dan lies entirely within Israel. The Banias originates in Syria but has been under Israeli control since 1967. The Wazzani stream, which rises in Lebanon, is the main source of the Hasbani. The Hasbani alone supplies about 25 percent of the Jordan River's water. The Upper Jordan then flows into the Sea of Galilee (Lake Tiberias). The Jordan River Basin is of great importance to Jordan, the Palestinian territories and Israel. Syria and Lebanon also contribute water resources to the basin, but rely far less heavily on it from a water abstraction point of view. The Jordan River suffers from both over-extraction and severe pollution and salinity problems. This is especially significant in years of drought (SIWI 2009).

Another important river in the region is the Litani River. The Litani basin lies entirely within Lebanon. At present, the Litani is not fully utilised. It is one of the only rivers in the area that continues to flow into the Eastern Mediterranean. Although not a shared water resource, the existing flow in the Litani River has reduced the need for Lebanon, in the short term, to divert greater quantities of water from the Wazzani and the shared basin of the Upper Jordan River.

The Yarmoukis the most significant tributary of the Lower Jordan River, reaching the river just below the Sea of Galilee/Lake Tiberias. The Lower Jordan then flows to the Dead Sea (one of seven basins that form the major Dead Sea Basin). The Yarmouk contributes all of the water of the King Abdullah canal, which supplies water to Jordan, largely for agriculture. The Yarmouk drains territories in Syria and Jordan and forms the border between Jordan and Syria. Further downstream, it forms the border between Jordan and Israel shortly before its confluence with the Lower Jordan River. From this point to the Dead Sea, the Lower Jordan forms the border between Jordan and Israel, and then between Jordan and the Palestinian territories. Because Israel, Jordan and Syria divert 95 percent of the water

that is supposed to feed the Lower Jordan River, the Lower Jordan has almost completely dried up. The flow that remains is fed by a few tiny springs and consists primarily of sewage and agricultural runoff, and is therefore quite polluted. The Jordan River Valley and the Dead Sea are among the world's cultural, religious and heritage sites. The Dead Sea has already shrunk by one-third in the past 50 years, and without these flows these sites will not remain as such.

The Nile is the longest international river system in the world. It flows for some 6,700 km through 10 countries before reaching the Mediterranean Sea. The Nile Basin covers roughly 2.9 million $km^2$, which is almost one-tenth the area of Africa (Gleick 1991). The river flows north for a distance of 6,500 km from 4" S to 31" N latitude, and extends from 21" 30' to 40" 30' E longitude. The Nile and its tributaries (White Nile, Blue Nile) flow through Tanzania, Uganda, Rwanda, Burundi, Zaire, Kenya, Ethiopia, Sudan and Egypt (Shahin 1985).

The linear warming trend over the last 50 years has been recorded as 0.13ºC per decade (IPCC 2007b). There has also been an increase in the number of heat waves, a reduction in the frequency and duration of frosts, and an increase in the frequency and intensity of extreme events in many parts of the world. Regarding these global trends, recent studies have found that the Arab region experienced an uneven increase in surface air temperature ranging from 0.2 to 2.0ºC that occurred from 1970 to 2004 (IPCC 2007a).

## Climatic trends Al Mashrek region

Earlier studies investigating the weather records in Jordan have shown an increase in the magnitude and frequency of extreme temperatures (Abdulla and Al-Omari 2008). Higher temperatures and lower precipitation are expected as a result of climate change. According to local climate change studies:

- a trend analysis has revealed a slight increase in the mean annual temperature; and
- the mean annual maximum temperature tends to increase slightly, while the mean annual minimum temperature tends to show a higher increase.

According to Jordan's Second and Third National Communications to the UNFCCC, annual precipitation has shown decreasing trends of 5 to 20 percent in the majority of stations in Jordan during the last 45 years, although a few stations, such as Ruwaished in the extreme east and Ras Muneef in the northwest, have experienced an increase in the amount of annual rainfall by 5 to 10 percent (JSNC 2009 and JTNC 2014). A greater amount of rainfall, with a decrease in the number of rainy days, may lead to an increase in daily rainfall intensity and, as a result, to an increased chance of recording extreme precipitation values. On the other hand, many other stations experienced an increasing number of rainy days associated with decreasing amounts of annual precipitation (JSNC 2009). In this case, a smaller amount of precipitation will be spread over a longer period of time, and consequently the daily rainfall intensity may be reduced. Increasing trends in relative humidity of 4 to 13 percent during the last three decades can be observed in the majority of the study locations (JSNC 2009).

Annual average precipitation is varied in the Al Mashrek region. In Lebanon and Syria, the average annual amounts of precipitation are 600 and 300 mm respectively. Iraq and Syria are partially dependent on the Tigris and Euphrates rivers, originating in Turkey. The two countries have rainfall of reasonable intensity, and groundwater potential in both countries is relatively high. Syria enjoys small flows caused by snow melt from the peaks of some local mountains. Lebanon depends on a number of local rivers or rivers shared with one or more of the neighbouring countries. The per capita shares of water in Lebanon as well as in Syria and Iraq are the highest among all Arab countries. Jordan and the Palestinian territories are the most water poor in the region, since they depend on the Jordan River and on small quantities of rainfall and groundwater.

Winter precipitation in the northern and north-eastern zones of Syria have shown signs of decrease for the last five decades, while autumn precipitation increased at stations that lie mostly in the northern zone of central Syria. Few stations statistically showed significant changes in spring and summer precipitation (Figure 3) (FNC_Syr 2009). A trend analysis applied to seasonally average annual temperature series between 1955 and 2006 shows a widespread rise in summer temperatures in all stations in Syria, with a significant increase in coastal and western regions. On the other hand, winter temperatures show a general tendency towards a decrease in Syria. This decrease is mostly noticeable in the costal stations, with a significant decrease in spring and autumn. An analysis of extreme events and indices shows significant increasing trends in the annual maximum of daily maximum and minimum temperatures, the annual minimum of the daily maximum surface air temperature, the annual minimum of the daily minimum surface air temperature, the number of tropical nights, and the number of summer days. The last of these denotes an increase in the number of warmer days and nights in the year. Nevertheless, significant decreasing trends in cool nights and days and the range of diurnal temperatures were also observed (FNC_Syr 2009).

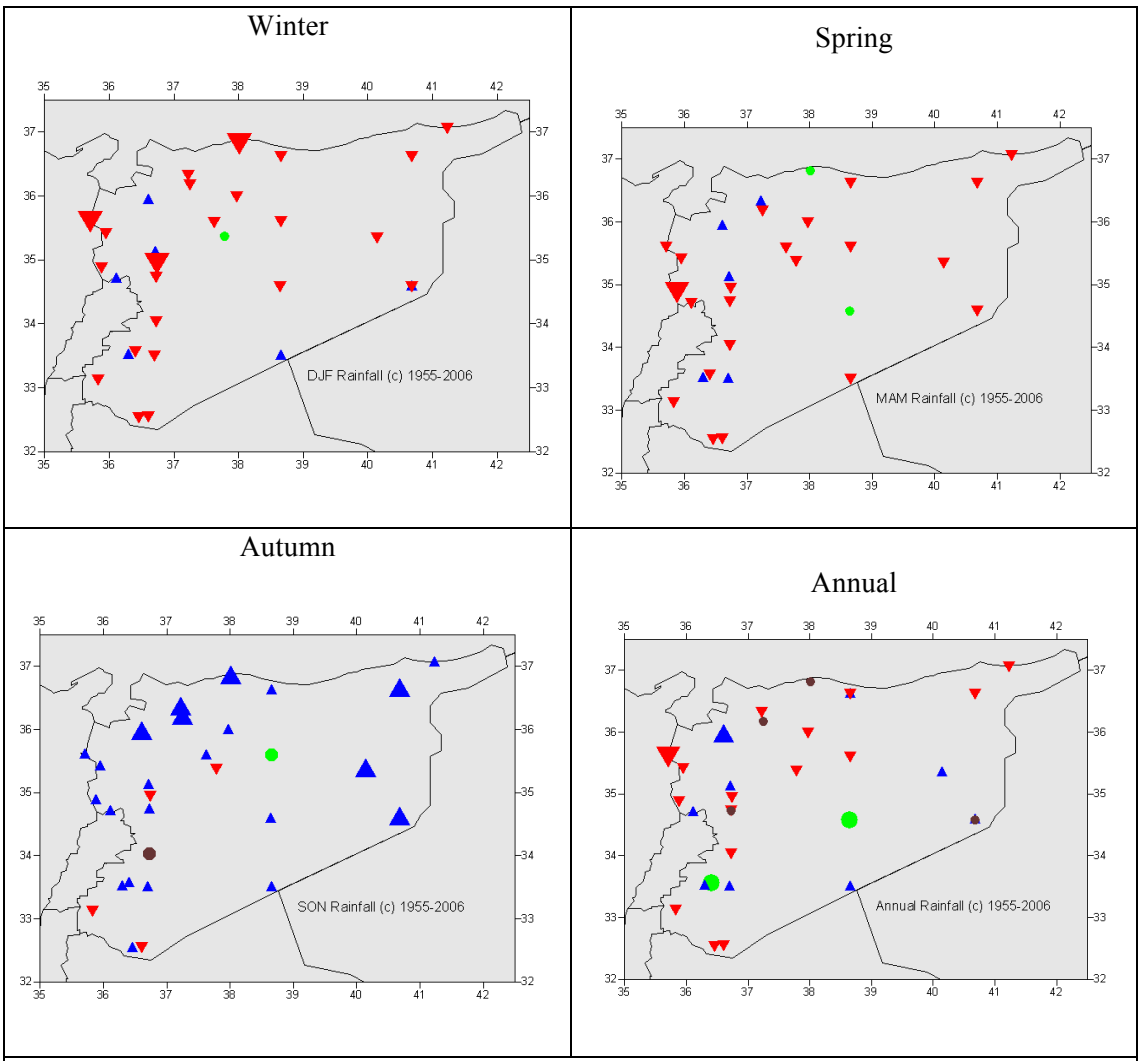


Figure 3. Seasonal and annual precipitation trends in Syria for the period 1955 to 2006

● no trend ▲ significant increase ▲ insignificant increase

▼ significant decrease ▼ insignificant decrease ● insignificant increase and decreases

(FNC_Syr 2009)

## Climatic trends in the Al Maghreb region

All five Maghreb countries depend mainly on rainfall and partially on modest groundwater reserves. Annual average precipitation is varied throughout the Al Maghreb region. The rate decreases gradually to 300 mm/year moving to the northern and eastern parts of the Mediterranean coast of Morocco and Tunisia. Average annual precipitation reaches 130 mm in North African countries.

The frequency of droughts has increased during the last 20 to 40 years in Morocco, Tunisia and Algeria. In Morocco, it has changed from an average of one year of drought in every five-year period prior to 1990, to one year of drought in every two-year period (Karrou 2002; Abbas 2002; Mougou and Mansour 2005).

The first signs of climate change impacts are appearing already in this region through both temperature and precipitation changes. Temperatures increased by 1 to 2°C during the 20th century. In Morocco, an examination of the last three decades (1970–2000) shows revealing signs of climate change, such as the frequency and intensity of droughts; unusually devastating floods; a decrease in the snow cover period on the peaks of the Rif and the Atlas mountains; the modification of spatial-temporal rainfall distribution; changes in the itinerary and passage dates of migrating birds; and the appearance of certain species of birds in the Rabat region that used to be seen only in the south of Marrakech.

In Mauritania, during the summer months, temperatures exceed 38°C, while in winter the temperatures average around 24°C. Most rain falls during the short rainy season, from July to September, and average annual precipitation varies greatly. The climate of the Senegal River Valley in the far south contrasts with that of the Saharan and Sahelian zones. Rainfall is higher than in other regions, ranging from 400 mm to 600 mm annually, usually between May and September. In the northern two-thirds of the country, average rainfall is less than 100 mm, where often isolated storms release large amounts of water in short periods of time. A year, or even several years may pass without any rain in some locations.

Rainfall amounts registered in Morocco, for example, show a negative trend at national and regional scales. Nationally, spring rainfall has declined by over 40 percent since the 1960s. Droughts are apparently becoming more persistent over time. The maximum length of dry spells is increasing during the rainy season, and significantly so at the end of this season (February to April), when it has increased by 15 days since the 1960s. At the same time, the total number of wet days shows a negative trend, revealing an increase in the annual dry day number. Many regions became more arid (according to the de Martonne aridity index) between 1961–1985 and 1986–2005: these include Oujda, Taza, Kenitra, Rabat and Meknès. The annual total number of cold days (days with a maximum temperature below 15°C) shows a negative trend, as does the duration of cold waves.

## Climatic trends in the Nile Basin Region

Egypt has the second lowest annual precipitation in the Arab region. During the period 1880 to 1989, the upper White Nile catchment, the upper Blue Nile catchment and the Middle Nile showed a decline in total precipitation. The southern part of Sudan enjoys ample precipitation that is able to meet the prevailing evaporative demand, although rain gradually vanishes north of the capital, Khartoum. The natural flow of the Nile forms 95 percent of the Egyptian water budget, with the remaining 5 percent composed of minor quantities of rain that fall on the coast of the Mediterranean Sea and Red Sea (about 1.5 billion $m^3$/year) plus modest reserves of groundwater aquifers.

The climate in Egypt has been changing along with the global change, but with lower rates of variation. There is a downward trend in maximum temperature over the delta, over the northern part of Upper Egypt and over the extreme south of Upper Egypt. This downward trend has ranged from -0.02°C to

0.06°C per year. Minimum temperatures have markedly increased over Egypt. An upward trend has covered most parts of Egypt, except a small area in Middle Egypt. The upward trend has culminated in increases of 0.1°C/year over southern parts of Upper Egypt. The main contributor to rising air temperature is the increase in night-time temperature. During the night, temperature rises at a higher rate than at any other time. This upward trend has culminated in increases of 0.05°C/year over the western part of the delta near the Mediterranean coast. The rise in night-time temperature may be due to the effect of greenhouse gases and increasing water vapour in the atmospheric boundary layer. Moreover, the rise in surface air temperature in Egypt is about 40 percent of the global rise in surface air temperature. Rainfall has increased over the western coast of Egypt by up to 3 mm/year.

### Climatic trends in the Arabian Peninsula

This is the poorest region with respect to water resources, and rainfall is rare by any standards. Groundwater in most of the countries in the region is not renewable according to many sources, thus continuous abstraction is increasing the depth of the water table and in some cases damaging water quality. The region depends for its water needs mainly on the desalination of water from the Gulf. Yemen is the only country in the Arabian Peninsula marked with extremely high summer temperatures, low intensity of rainfall and declining groundwater levels due to over pumping and obviously high evapotranspiration rates. The area has more than half of the world's proven oil and natural gas reserves, which enable most of the countries to adopt state-of-the-art international technology for the desalination of seawater.

Kuwait has the poorest water resources in the Arab region, with average precipitation of 121 mm/year, total annual water of 0.02 billion $m^3$and a 100 percent dependency ratio. In the United Arab Emirates (UAE), average annual rainfall over the period 1970–2001 was about 120 mm, with rainfall in the driest years being over 20 times below rainfall levels in the wettest years. Average monthly rainfall patterns fluctuate widely throughout the year, with most of the rainfall occurring between January and April when temperatures are lowest. These rainfall levels, while showing a large range across the Emirates in the winter months (especially March), are uniformly very low across the UAE during the summer months between July and October (United Arab Emirates Initial National Communication [UAE_INC] 2006).

Average temperatures also show significant variation across the UAE over time. The annual average temperature is about 27°C over the 1970–2001 period. Average monthly temperatures for the UAE over this period show clear trends. The range in maximum observed monthly temperatures is highest in the summer months, reaching nearly 6°C across the UAE. The range in minimum observed monthly temperatures occurs during the winter months, when there is about 11°C between the minimum temperatures throughout the country (UAE_INC 2006).

### Climatic trends in the Sahel countries

Somalia, Djibouti and the Comoros Islands are all dependent on rainfall, with modest potential from groundwater. With regard to changes in precipitation, an average of a 25 percent decrease in rainfall has occurred over the African Sahel during the past 30 years.

The change has been characterised by a decrease in the number of rainfall events. A decrease in precipitation has occurred over the 20th century, particularly after the 1960s, in the subtropics and the tropics from Africa to Indonesia (IPCC 2001).

The Third Assessment Report (TAR) suggests that climate change is likely to be associated with increased water stress in much of Africa. Moreover, it reports that scenarios for the Sahel region, based on Hulme (2001), are ambiguous (IPCC 2001), reflecting the lack of information on the current state of

water resources. An assessment by UNEP (2002) suggests that by 2050 rainfall in Africa could decline by 5 percent and become more variable year by year.

## Projected climate change in the Arab region

In 2007, the Intergovernmental Panel on Climate Change — an international group of climate scientists — issued an assessment of projected climate change impacts around the world. This report, the Fourth Assessment Report (FAR), estimates that the average temperature of the Middle East region will increase by about 1 to 2°C between 2030 and 2050. This would result in higher evaporation rates, causing soil degradation across large areas of land in the region. The Arab region is a vast zone of generally diverse climatic conditions, characterised by very low and highly variable annual rainfall and a high degree of aridity (FAOa 2002). Most of the Arab region lands are classified as hyper-arid, semi-arid and arid land zones (WRI 2002). Most recent assessments have concluded that arid and semi-arid regions are highly vulnerable to climate change (IPCC 2007a).

For the next two decades, a warming of about 0.2ºC per decade is projected for a range of IPCC SRES emission scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1ºC per decade would be expected (IPCC 2007b).

According to climate change studies, the Arab region will face an increase of 2ºC to 5.5ºC in surface temperature by the end of the 21st century. This increase will be coupled with a projected decrease in precipitation from 0 to 20 percent. These projected changes will lead to shorter winters, drier and hotter summers, a higher rate of heat waves, a higher level of weather variability and a more frequent occurrence of extreme weather events.

For the Arab region, future projections using climate models point to an increase in the mean annual temperature by 0.5 to 1.0°C in 2030, by 1 to 1.5°C in 2070, and by 2.5 to 3.0°C in year 2100. They also show a decreasing trend in annual precipitation by 10 to 20 percent in the Mediterranean region and north of the Arab Peninsula. Simulated ranges of warming for the Arab region (IPCC 2007a), in the best scenario are as follows: by 2030, annual average temperatures will be 0.5 to 1.0°C higher over most of the Arab region; by 2070, the increase in annual average temperatures will range from 1 to 1.5°C;and by 2100 the increase in annual average temperatures is predicted to reach 2.5 to 3.0°C. Model results indicate that future increases in daily maximum and minimum temperatures will be similar to the changes in average temperature.

In the worst scenario, by 2030 annual average temperatures are 1 to 1.5°C higher over most of the Arab region. By 2070, the increase in annual average temperatures will range from 2 to 2.5°C, and by 2100, the increase in annual average temperatures is predicted to reach 3 to 4°C (Figure 4).

Preliminary climate change and climate variability scenarios for the Arab region indicate that rainfall in the region will become intense and dry spells will become more pronounced

Most Arab countries have submitted their initial and second national communications to the UNFCCC (Jordan in 1997, 2009, 2014; Egypt in 1999; Tunisia in 2001; Bahrain in 2005; the UAE in 2006; and Syria in 2009). Studies carried out for these communication reports focused on the impacts of climate change on the water resources, agriculture and livestock sectors. They conclude that water resources, environment and other related issues such as land use and livestock are most likely to be vulnerable to climate change.

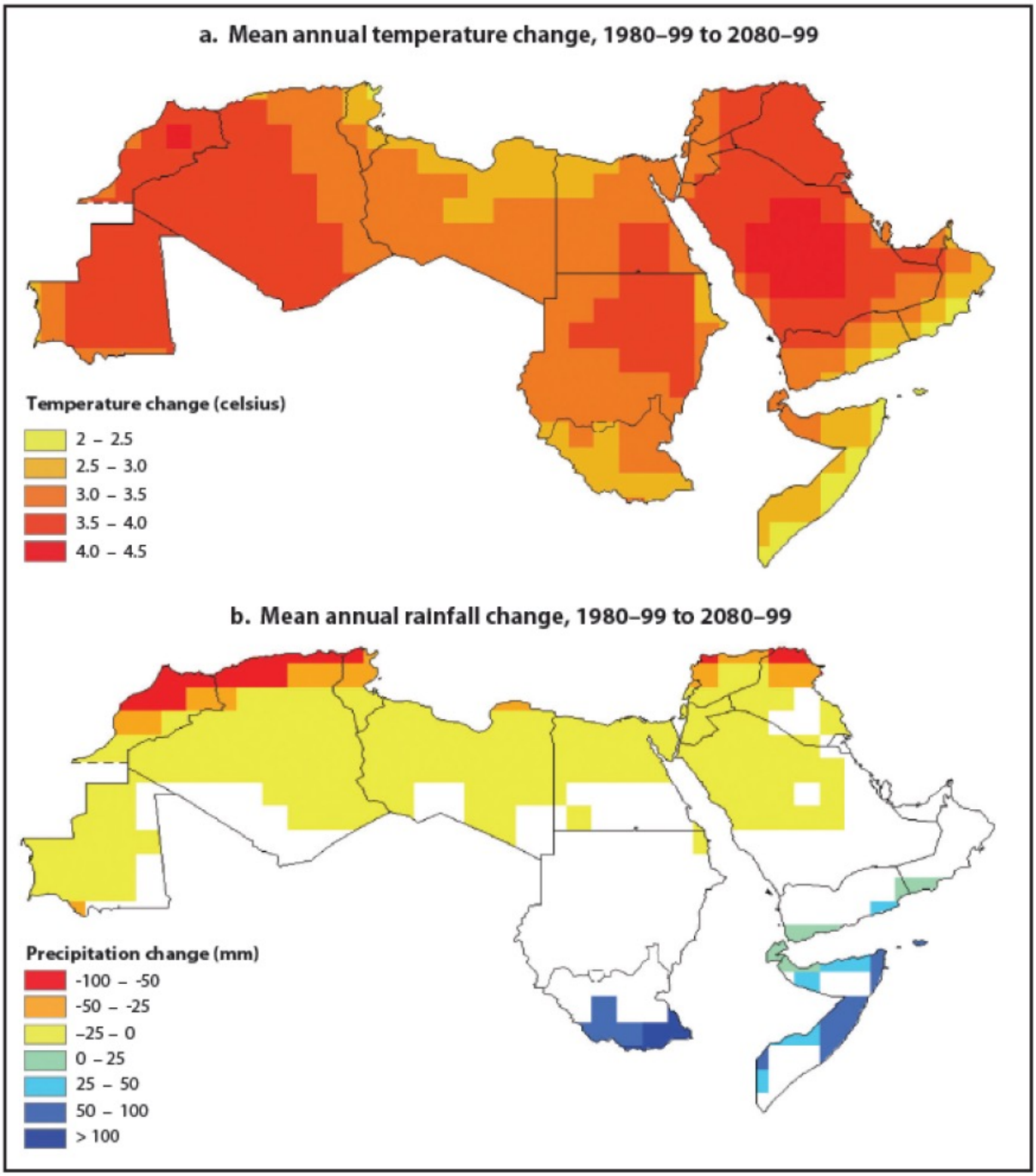


**Figure 4: Projected climate change for the late 21st century: Most of the region will be significantly hotter and drier (Drote Verner 2012)**

## Climate change risks to surface water resources in the Arab region

Most Arab countries are located in arid and semi-arid regions that are characterised by low and limited water resources and high evaporation. The Arab region is one of the world's driest, most water scarce regions, and depends on climate-sensitive agriculture. It is expected to face severe water shortages in the near future. Per capita renewable water resources in the region, which in 1950 were 4,000 $m^3$ per year, are currently 1,100 $m^3$ per year. Fresh water resources are less than 1,000 $m^3$ per capita per year in nine out of 14 countries, and this limited supply is currently being depleted at a rapid rate by the growing economic development in the region. Projections indicate that they will drop by half, reaching

550 $m^3$ per person per year in 2050 (World Bank 2006). The IPCC has stated with great confidence that the Arab region will suffer a decrease in water resources due to climate change (Kundzewicz et al. 2007). Unfortunately, comprehensive studies on climate change vulnerability and adaptation requirements are limited in most Arab countries. With climate change, water resources will be further stressed due to increased droughts and the anticipated increase in evaporation and evapotranspiration.

The main consequences of climate change related to water resources in the Arab region can, conceptually, be attributed to increases in temperature, lower soil humidity, higher evaporation-transpiration, shifts in precipitation patterns in terms of temporal and geographic distribution, extreme annual and seasonal variability, downpours and flash flooding, frequent droughts and desertification, less snow cover at high altitudes (mountain terrains in Lebanon, the Syrian Arab Republic and, to a far smaller extent, Iraq), and the possible damaging impact of future sea level rises on near-shore fresh groundwater resources.

The overall picture that emerges from the limited literature on the region and from IPCC projections (2007a) indicates that water availability will be highly sensitive to climate change. Climate change will have significant impacts on freshwater, affecting both the availability of freshwater and the frequency of floods and droughts in the Arab region. Climate change may undermine national development plans, affect human security and livelihoods, have a significant impact on agriculture, tourism and industry, and act as a push factor in population movements and migration.

In addition, climate-induced resource scarcity could exacerbate tensions in the region's conflict-ridden areas, potentially escalating violence and political turmoil even beyond the region's boundaries. This is supported by the fact that 80 percent of surface water resources and 66 percent of total water resources in the Arab region are shared water resources. Higher temperatures and reduced precipitation will increase the occurrence of droughts, an effect that is already apparent in many Arab countries such as Jordan and Syria. Climate change will also require a more severe adjustment in the management of the region's water resources than any other region, since most of the water resources are already being exploited for human uses.

Furthermore, climate change is expected to have a negative impact on water quality (by the pollution of surface water and seawater intrusion to groundwater aquifers). The expected changes will undoubtedly have impacts on all the socioeconomic and environmental goods and services that depend on these variables, either directly or indirectly. The consequences are far-reaching in the Arab region and are likely to be felt the hardest by the most vulnerable groups such as women, the elderly, children, the poor and the disadvantaged.

Moreover, a warmer climate, with its increased climate variability, will increase the risk of both floods and droughts (Wetherald and Manabe 2002). Areas affected by drought will probably increase, and extreme precipitation events, which are likely to increase in frequency and intensity, will augment flood risk. The increased frequency and severity of floods and droughts will also have implications for sustainable development (IPCC 2007a). Water shortages are already the main constraint in most countries of the region, and IPCC model simulations indicate that water scarcity may worsen substantially as a result of future changes in climatic patterns. The change in the value of surface runoff will depend on the changes in temperature and precipitation, among other variables. A 2008 study conducted by Abdulla and Al-Omari shows that a rise in temperature of 2 to 4°C in Jordan will reduce the flow of the Zarqa River by between 12 and 40 percent.

Climate change may significantly damage surface water quality, as intense rainfall may generate significant surface runoff that may carry significant sediment loads containing pesticides, fertilisers and

waste. This will increase siltation in steams, lakes and impoundments. Warmer water temperatures may have further direct impacts on water quality, such as reducing dissolved oxygen concentrations. Cold-water species, such as most salmon and trout, are particularly susceptible to warm water temperatures, and increasingly frequent warm water conditions could bring new challenges to the way managed river systems are controlled. Where stream flows and lake levels decline due to evaporative water losses, the salinity of surface waters, especially in lakes and reservoirs with long residence times, could increase. These stresses on water quality will increase if climate change leads to longer dry spells.

## Climate change risks to groundwater resources in the Arab region

There has been very little research on the impact of climate change on groundwater (Alley 2001; Kundzewicz et al. 2007). There has likewise been limited work on how climate change might affect groundwater in arid and semi-arid regions, including the Arab region. Studies of the effects of climate change on recharge need to consider changes in precipitation variability and inundation (Khiyami et al. 2005). Locally, recharge is a function of precipitation, in terms of both amount and timing, the soil and vadose zone properties, evaporation, and transpiration. Recharge can also be greatly affected by changes in land use, such as going from grassland or woodland to agriculture. Outside of soil and vadose zone properties, climate change is expected to affect all of these factors. The amount and timing of precipitation has been previously discussed. Increases or decreases in evaporation are a function of temperature as well as humidity, which is tied to precipitation. Globally, increased $CO_2$ in the atmosphere is expected to decrease transpiration (Betts et al. 2007 and Leipprand and Gerten 2006, both as cited by Kundzewicz et al. 2007); however, transpiration will vary locally depending on the local changes in temperature, precipitation and vegetation type. Local increases in evaporation and transpiration could increase the salination of soils.

The IPCC has noted that there is no ubiquitous trend in groundwater systems that can be directly correlated to climate change, primarily because of the lack of data (Kundzewicz et al. 2007). We believe this is due, in part, to uncertainties in estimating recharge and teasing out what component of recharge is natural or influenced by land-use change, let alone changes in climate, especially when those changes, current and projected, are of far smaller magnitude than natural variations. Furthermore, in many aquifers it takes time for water to reach the water table, and the water that reaches the entirety of the water table represents an integration of past climatic conditions over years, decades, and perhaps centuries.

The consumption of groundwater is likely to become unsustainable. According to the IPCC, the unsustainable depletion of groundwater is likely to be worsened by reduced surface water infiltration in the Arab region. In addition, the increase in the intrusion of salt water to coastal aquifers from sea level rise will further reduce the availability of usable groundwater (IPCC 2007d). Climate change could affect groundwater resources by affecting recharge, pumping, natural discharge and saline intrusion. Some of these effects are direct, and some are indirect. Recharge is an obvious parameter that is affected by climate change as it is closely tied to precipitation. If there is more precipitation there will probably be more recharge, and if there is less precipitation there will probably be less recharge. Moreover, sea-level rise will extend the area of saline groundwater, resulting in a decrease in freshwater availability for humans and ecosystems in coastal areas (Bobba et al. 2000). In addition, groundwater recharge will decrease considerably in some already water-stressed regions (Döll and Flörke 2005).

Climate change may have a negative impact on the quality of groundwater. In coastal zones, for example, changing recharge patterns, including reduced long-term recharge and/or temporally variable recharge, coupled with rising sea levels, will increase the likelihood of seawater intrusion, thereby damaging water quality in the aquifers. Moreover, increased sea level would also lead to

significant problems in terms of population dislocation. In Saudi Arabia, it is expected that the seawater level will increase by 50 cm, and this will result in losing 3,747 hectares of costal area. In Bahrain, the rising seawater level will result in the loss of 5 to 10 percent of the total area of the country.

Preliminary climate change and climate variability scenarios for the Arab region indicate that rainfall in the region will become intense and dry spells will become more pronounced. Increased rainfall intensity is expected to lead to reduced infiltration and potential aquifer charge. The potential sensitivity of aquifer recharge to precipitation is summarised by Döll and Flörke (2005), who show that the increase in surface temperature and the reduction in rainfall will result in a 30 to 70 percent reduction in recharge in an aquifer located on the eastern and southern Mediterranean coast.

Groundwater supplies will be at great risk from rising sea levels in ESCWA member countries. Higher sea levels would cause seawater intrusion leading to the salinisation of ESCWA groundwater aquifers close to coastlines. Excessive withdrawal from aquifers will exacerbate the problem. Furthermore, many general circulation models suggest greater precipitation variability, and downpours will become more intense. This would increase runoff and flash floods while reducing the ability of water to infiltrate the soil to recharge the aquifers (e.g. the case of hurricane Gono in Oman). Conceptually, seawater intrusion to coastal groundwater resources might pose a threat to Egypt, Lebanon, the Syrian Arab Republic and the Gulf States.

## Climate change adaptation and mitigation in the Arab region

Over the past decade or more, the national and international focus has been predominantly on strategies to reduce greenhouse gas emissions. In many countries, and in the international negotiations on climate change, there has been an unwillingness to devote serious attention to adaptation strategies. Some level of climate change is inevitable, irrespective of emission reduction strategies. This inevitability is reflected in the conclusion stated by the IPCC in their 2001 Assessment Report that adaptation is now a necessary strategy to complement emission mitigation efforts.

An adaptation strategy, in order to be effective, must result in climate risk being considered as a normal part of decision making, allowing governments, businesses and individuals to reflect their risk preferences just as they would for other risk assessments. In this sense, adaptation strategies will fail if they continue, in the long run, to be seen in a “silo” separate from other dimensions of strategic planning and risk management. To reach this point, however, is going to require a period of awareness raising, the development of the science, and the development of techniques for applying it in practical situations. This is a common path in developing public policy in “new” fields. The first step is to identify priorities.

Many human and natural systems are strongly influenced by the climate. All of our natural ecosystems have evolved in variable, but generally slowly changing, climate patterns. Industries and communities are also affected by climate factors. Climate can influence productivity and the reliability of supply. Communities also expect that our cities and infrastructure will cope with severe weather events efficiently and safely. Improved technical knowledge and modern communications are tending to increase understanding of the relationship between climate exposure and national welfare.

Although climate change is projected to have serious impacts on water resources in the Arab region, only modest efforts and steps are being taken in scientific research related to mitigation and adaptation. The scientific community in most Arab countries is still suspicious regarding climate change phenomena, and remains hesitant to acknowledge the risks. In addition, Arab countries, like other developing countries, have low adaptive capacity to withstand the adverse impacts of climate change due to the high dependence of a majority of the population on climate-sensitive sectors such as

agriculture and water resources, coupled with poor infrastructure facilities, weak institutional mechanisms and a lack of financial resources. Arab countries are, therefore, seriously concerned with the possible impacts of climate change, such as:

- water stress and a reduction in the availability of freshwater due to a potential decline in rainfall;
- threats to agriculture and food security, since most agricultural activities are either rain-fed agriculture (e.g. in Jordan, where about 71 percent of cultivated land is rain fed) or irrigated agriculture (e.g. Egypt, where more than 90 percent of the cultivated area is irrigated);
- threats to biodiversity, with adverse implications for forest-dependent communities;
- adverse impacts on natural ecosystems, such as wadi systems, and coral reefs in Arab cities located on the Red Sea, as well as grasslands and mountain ecosystems; and
- impacts on human health due to the increase in vector- and water-borne diseases.

The impacts of climate change are inevitable and raise issues of adaptation. Although climate change will affect virtually every sector and region, this part of the study looks at the water resources sector in Arab countries in order to illustrate the nature of adaptation problems and policy research needs.

The Council of Arab Ministers Responsible for the Environment, at its 19$^{th}$ session held at the headquarters of the League of Arab States on December 5 and 6, 2007, adopted the Arab Ministerial Declaration on Climate Change (AMDCC), which constitutes the basis for future action and reflects the Arab position in dealing with climate change issues, as follows (AMDCC 2007): In most Arab countries, comprehensive national policies to address climate changes have not been adopted to date. In the last two decades a range of acts, regulations and measures, policies and strategies directly related to water scarcity and indirectly related to climate change, have been developed and even adopted. However, the effective implementation of climate change measures may require the development of response measures that are primarily designed to achieve other development objectives. Therefore, the development of mitigation and adaptation strategies to protect water resources in the Arab region is required if national socioeconomic goals are to be attained.

The aim of mitigation and adaptation strategies is to develop a climate change policy that is specifically geared towards more vulnerable sectors in the country and to establish a public policy that encourages and supports adaptation at local or community level and in the private sector. Another goal is the development of sustainable economic growth, which, in turn, allows for a greater allocation of resources to the development of adaptive technologies and innovations. Expected outcomes from these proposed policy actions are the following:

- reduced vulnerability;
- adaptation to expected climate changes;
- the promotion of sustainable development;
- a reduction in poverty;
- environmental protection;
- institution strengthening;
- capacity building on climate change;
- the establishment of a legal framework to address climate change; and
- greater public awareness of climate change.

In this study, adaptation measures are suggested along with the current policies and their implications for the vulnerability of different sectors. The proposed adaptation measures can be included as projects within each national action plan for climate change. The proposed projects have many cross-

cutting issues with other sectors and should therefore be compiled with similar projects under the same programmes. Adaptation policies should be implemented to enhance and facilitate actions that will reduce Arab countries' vulnerability and improve their resilience to climate change. For adaptation measures to be successful, leadership is required to inspire confidence and agreement among all levels of government, the private sector and civil society

Prioritising adaptation action requires the identification of vulnerable systems — both human and natural, such as the water sector — the costs if these fail, the scope to reduce this risk, and the ability to capture any potential benefits. Vulnerability is a function of exposure to climate factors, sensitivity to change and capacity to adapt to that change. Systems that are highly exposed, sensitive and less able to adapt are vulnerable. Adaptation strategies therefore involve the identification of sectors/systems/regions vulnerable to change and an examination of the scope to increase the coping capacity of those systems — that is, their resilience — which, in turn, will decrease their vulnerability. Prioritisation will also depend on identifying vulnerable systems or regions whose failure or reduction is likely to carry the most significant consequences.

## Adaptation measures for the water resources sector

The availability of water is essential for many industries and other natural resources. Every major mainland city already faces water stress. In many cases, climate change will increase these pressures through higher temperatures and possibly lower rainfall combined with more frequent El Niño–Southern Oscillation (ENSO) events. Dams could be susceptible to extreme rainfall events if these events exceed historical design standards. Dam overtopping and failure can have catastrophic short- and medium-term effects in terms of human and economic losses.

Adaptation options for urban water and dams could include the systematic inclusion of climate risk — on both the supply and demand side — in all major urban catchments. There is much work already progressing in this area. Similarly, collaborative work on the assessment of non–conventional water supply sources — desalination, water recycling — and on demand management could be a high priority under national water strategies.

The projected impact of climate change globally is likely to exacerbate water stress and shortages in one part of the Arab region, and increased flooding in another. There is thus a need to develop and implement adaptation measures. These strategies may range from changes in land use and cropping patterns to water conservation, flood warning systems, crop insurance etc.

Measures already adopted to counter the growing water scarcity in Arab countries, such as water conservation, finding additional water sources (desalination and wastewater reuse) and water demand management, will also serve as future adaptation to climate change. In their efforts to adapt to climate change and water scarcity problems, ministries of water in Arab countries have issued water strategies and several policies to conserve water and seek alternative supplies. In addition to optimising the use of rainfall-fed recharge in some basins, augmenting storage in the main basins and increasing water-use efficiency, water harvesting systems, wastewater reuse, virtual water and desalination have been identified as potential measures to adapt to water scarcity.

The future strategies that will be formulated in Arab countries for coping with climate change impacts on national water resources will be similar to the current strategies for coping with the ever-increasing demands and shortages. A prerequisite for adaptation is the application of an integrated water resources management strategy at different levels of usage, from individual households to local communities, and from watersheds to catchments. Current strategies for adapting to the two extreme events, namely floods and droughts, will hold good even under the projected impacts of climate

change. The present structural or non-structural measures of surface water storage will continue to be valid.

Improving water availability through the year, soil and water conservation, equitable water distribution, traditional water conservation practices, and groundwater recharge are examples of adaptation strategies.

There is no single "best" coping strategy. The best choice is a function of many factors pertaining to economic efficiency, risk reduction, robustness, resilience, reliability etc. The emerging technologies for short-term weather forecasting for real-time water management and operations have great potential to enhance coping capabilities in the face of climate variability and change. Such advances will greatly improve irrigation water management efficiency. Biotechnology can potentially help to increase crop yields while reducing water requirement and to develop crops that are less dependent on water.

Adaptation strategies for the water resources sector may be developed in response to the results of water resources management models, or may be suggested as general guidelines to enhance the overall efficiency of water resources operations. The sector has much scope for adaptation and has also shown capacity to adapt in the past.

Water vulnerability and adaptation to climate change should therefore be part of the sustainable water resources environment and integrated development policies designed to:

- build on the existing policies to protect water resources, the environment and economic development against the current climate (the adaptation baseline); and
- make incremental changes to the adaptation baseline to mitigate the direct and indirect effects of climate change (climate change adaptation).

Taking into account the scarcity of water resources and their anticipated decrease in many Arab countries resulting from climate change, the following adaptation measures can be taken:

- building institutional and technical capacity;
- promoting information exchange and multidisciplinary linkages; and
- strengthening regional cooperation.

Mitigating climate change impacts necessitates the enhancement of regional cooperation, since climate change will have an impact on all countries in the Arab region. It is essential to establish a regional early warning system, the main mission of which is the forecasting and risk assessment of extreme events (i.e. droughts and floods).

### *Finalising shared water resources agreements*

As mentioned above, climate change may also reduce shared water resources such as the flow of the Euphrates and Tigris, by as much as 30 to 50 percent (ESCWA 2008). The same is true in the case of other rivers shared between Lebanon and Jordan. In the meantime, water demand will continue to increase in different countries that share the same water bodies, due to population growth and the rise in atmospheric temperature, which leads to increased evapotranspiration rates and an increase in water demand for agriculture. All these issues will be faced by the different countries of the region, where most water resources are shared, and will therefore raise the issue of equity and increase the potential for political conflict.

*Surface water development*

- The development and use of surface water should be optimised through supply-enhancing measures, including surface and subsurface storage; the minimising of losses due to surface evaporation and seepage; soil and water programmes; and the protection of surface water supplies from pollution.
- Sustainable management plans should be developed for surface water in wadi systems; open canal systems should be converted to a pressurised pipe system, giving priority to modernising and upgrading the systems; and precedence should be given to water projects that make significant contributions to meeting rising municipal and industrial demand.
- Dams are required for storing floodwater during the wet, winter season and releasing the water gradually during the summer season when demand is high. Besides these "ordinary" reservoirs, so-called desert dams (water harvesting) can help to increase groundwater recharge and provide water for pastoral use. The use of *hafeer*s, contour bunding, gully plugging, and check dams and dykes should be promoted to catch rainwater and increase the amount of water available for agricultural use.

*Groundwater protection*

Most groundwater aquifers are exploited at more than double their safe yield on average. The sustainability of irrigation in the highlands and Badia areas will be greatly endangered unless strict measures are taken to address this issue. As such, the development and implementation of an action plan is needed in order to ensure that plans for groundwater protection, management, monitoring and restoration are defined, integrated and managed in a cost-effective manner (JSNC 2009).

In order to improve the groundwater situation in Jordan, the Ministry of Water and Irrigation is establishing an integrated programme to assess the availability and exploitability of all resources at rates that can be sustained over long periods of time.

The mining of renewable groundwater aquifers will be checked, controlled, and reduced to sustainable extraction rates. The ministry will further encourage applied research activities, including artificial recharge to increase groundwater supplies, and the employment of new technologies that will optimise the operation and development of groundwater systems and promote their more efficient and feasible use.

The existing laws in Jordan are strong enough to control the use of and protect groundwater resources. However, the application of these laws is still unsatisfactory, suggesting a need for the future strengthening of law enforcement through an adequate penalty system. The guidelines for the implementation of groundwater protection are being prepared. The implementation of these areas requires not only legal, but also technical and institutional, support.

The priority actions needed for groundwater resources protection in Bahrain are (Al-Jeneid et al. 2008):

- the formulation of integrated water resources management plans to rationalise water use and protect aquifers from being excessively salinised; and
- the legalisation and institutionalisation of the reuse of treated sewage water.

*Enhancing the use and development of non-conventional water resources*

Non-conventional water resources may be defined as water resources that are not readily available or suitable for direct beneficial use, including wastewater reuse, water desalination and weather modification. The enhanced use of alternative water resources such as reused municipal wastewater, seawater/brackish water desalination, and the use of submarine springs with significant flows can be found along the Lebanese and Syrian coastal areas. The most common source of non-conventional

water is the treatment of domestic and industrial wastewater. Wastewater reuse is becoming more popular throughout the world, particularly in arid and semi-arid regions, because it can reduce environmental and health-related hazards if planned properly and can also increase crop yields due to supplemental irrigation and the nutrients within the wastewater.

Jordan provides a good example of the use of this source of water to alleviate water scarcity. In the last three decades, about 25 municipal wastewater treatment plants have been in operation in Jordan. The plan is for the effluent from these plants to be used for irrigation around the plants or discharged to wadis or reservoirs, where it is diluted and utilised for agriculture.

Brackish water is another non-conventional source of water that can be utilised after treatment. In order to further pursue the brackish water option, ministries of water in the Arab countries should assess the potential of brackish water resources in terms of sound technical, economic and environmental feasibility in all groundwater basins, and then carry out research and studies on desalination and on the optimisation of brackish water use in agriculture and industry.

### *Water quality and the environment*

Arab countries have witnessed some deterioration in water quality in the last two decades, due to industrial pollution, the overuse of agrochemicals, drainage water, the overloading of wastewater treatment plants, the over-pumping of aquifers, seepage from landfills and septic tanks, and the improper disposal of dangerous chemicals by certain industries. The overloading of the existing wastewater treatment plants due to high population growth and social development has caused a further deterioration in the effluent from most of the plants. The performance of many of the plants is inadequate, resulting in low-quality effluent. This effluent may have an adverse effect on public health due to the presence of pathogens, or to the accumulation of toxins in soils irrigated using the effluent. Furthermore, the pollution of surface water and groundwater due to seepage will result in a deterioration of the quality of some water resources and will limit their use for different purposes. It is essential to enforce standards for wastewater discharges to sewers, treated effluent and water for other uses. The standards adopted should take into consideration national priorities, economics and the availability of water supplies, as well as health and other environmental implications. The implementation of standards and their enforcement require facilities and expertise, which involve significant costs. Enforcement, in particular, requires commitment and coordination between many agencies and at many levels within the government. The adoption and implementation by water ministries in Arab countries, in cooperation with other related ministries, of guidelines for water used in irrigation, increases the availability of water that can be used in irrigation.

### *Strengthening the water resources monitoring system*

It is important to enhance monitoring efforts in order to improve data for weather, climate and hydrological modelling so as to contribute to an understanding of water-related impacts and management strategies. In addition, databases that support water resources and environmental management should be integrated.

### *Measures to improve system efficiency*

The overall efficiency of the water resources system is low due to losses in the system, system constraints and inefficient farm practices, as well as to funding constraints and constraints in inflow patterns. In the precipitation increase scenario, adaptation measures to increase efficiency may include the adoption of better farm management and irrigation practices. Special care would need to be taken to control high waters in the root zone, which considerably reduce crop acreage. Precision land levelling and proper field sizing may be required.

*Implementation of integrated watershed management practices*

The implementation of integrated watershed management practices can play an important role in the rationalisation of resource use and the allocation and protection of water sources (both surface water and groundwater), and pricing and market mechanisms can be used proactively to increase the efficiency of water use. An effective and economically beneficial adaptation option is the construction of dams on all potential wadis. The finite nature of renewable freshwater makes it a critical natural resource to be examined in the context of population growth and climatic changes. Freshwater availability is dictated, to a large extent, by the climate, and particularly by the timing and location of precipitation and by evaporation rates, and varies tremendously from season to season. Watershed protection would also have benefits for groundwater storage and flood alleviation.

*Urban water use*

There is an urgent need to devise policies, both economic and structural, for water conservation in urban areas in order to lower the rising pressure on drainage and supply systems and to lower the pressure on sewage treatment, which has become essential for the preservation of water quality.

*Flood control*

Flash floods have varying impacts on different areas (desert wadis and rural areas). Proper risk and vulnerability analyses for each flood-prone area need to be carried out for a changing climate. For vulnerable areas, current topographical maps are needed. Flood control authorities should keep up-to-date records of settlements and infrastructure development. Clearance from the flood protection agency may be required for the construction of settlements and infrastructure in new areas.

*Research programmes*

In Arab countries, few and limited studies have been published in the field of climate change, and there are many gaps that still need to be filled in the future, especially pertaining to the vulnerability and adaptation of the water resources, agriculture and health sectors. Climate change studies are based, in most cases, on the use of modelling, remote sensing and projection techniques, but, due to the lack of facilities and the low level of allocated funds for Arab research institutions, empirical and experimental techniques are still applied.

The assessment of climate change impacts, and of vulnerability and adaptation to climate change, requires a wide range of physical, biological and socioeconomic models, methods, tools and data. Methods for assessing vulnerability, impacts and adaptation are gradually improving, but are still inadequate to help policy makers formulate appropriate adaptation measures. This is due to uncertainties in regional climate projections, the unpredictable responses of natural and socioeconomic systems, and the inability to foresee future technological developments.

Continuing research will lead to better and more precise information about the impacts of climate change on water resources over the Arab region. Using statistical and dynamic downscaling with regional models opens doors to generating high-resolution climate change scenarios and to investigating their impacts on a regional scale.

Natural resource planning for the future is difficult without more significant and reliable data that takes into consideration demographic variations, and without an understanding of the phenomenological responses of the biological ecosystem to climatic changes. Mathematical models and research are needed in order to find out the phenomenological responses of various subsystems of the environment, making it possible to assess the impacts of climate change on sectors such as water resources.

Few and limited studies on mitigation and adaptation have been developed in Arab countries. In Morocco, a drought insurance programme based on rainfall contracts is an important example of an adaptation strategy and had a potentially significant benefit over the current scheme, minimising drought hazard and protecting cereal production (IUCN 2003). Shoreline protection along the northern coast of Egypt is another obvious example of an adaptation strategy (El-Raey 1999).

### *Public awareness and stakeholder capacity programmes*

Public awareness of climate change in Arab countries is still at an early stage of development, and most countries have highlighted the challenges they face in improving it. Arab society is not aware of the consequences of global climate change and greater environmental public awareness is needed. This process needs to be facilitated by public debates, increased media interest in the problem, and more intense activities by NGOs. Public interest and support are crucial for the application of the long-term governmental strategy and climate change policy. Few NGOs in Arab countries are interested in climate change or the dissemination of related information.

There is a need for capacity building to enable the environmental authority to play a major role in planning, coordinating and implementing adaptation programmes of action. The capacity of the environmental authority needs to be strengthened in terms of human, financial, technical and technological resources. Awareness can be raised via workshops, radio and television programmes, newspapers, films, pamphlets and websites.

### *Barriers to increased adaptive capacity*

Each country has its own specific barriers to the implementation of adaptation and mitigation measures, such as limitations in financial and technical resources, human and institutional capacity, the legislative framework, and public support. The vulnerability and adaptation assessments in the first and second national communications carried out by various Arab countries identified the following barriers to adaptive capacity in the water sector:

- inadequate conveyance, collection and treatment infrastructure;
- poor or missing industrial pre-treatment;
- poor or inadequate facility operation maintenance programmes;
- inadequate access to technology;
- insufficient capital to fund a domestic wastewater pollution management programme;
- limited human resources, equipment and facilities at water ministries as well as other related ministries;
- a lack of coordination and the poor exchange of knowledge and experience among agencies associated with wastewater reuse as well as with national or municipal-level planning programmes;
- weak capacity in terms of conducting surveys, assessments, investigations and applied scientific studies to evaluate and predict health impacts caused by wastewater reuse;
- the limited number of educational and awareness-raising programmes on safe wastewater reuse;
- a lack of enforcement of existing regulations;
- inadequate inventories of communities' use of treated wastewater;
- the lack of classification of sensitive or unique water bodies, watersheds, habitats or ecosystems;
- poor or missing monitoring for assessing environmental progress;
- lack of stakeholder participation;
- limited studies on diseases associated with wastewater discharge or reuse;

- lack of financial resources to implement climate change adaptation measures;
- lack of a clear and specific legal and policy framework for climate change issues in the country (There is no legal framework directed to ensuring that climate change issues at various levels are properly institutionalised in the planning process. This is because most adaptation interventions that are identified to reduce the risks of increasing climate variability would require the further "fine-tuning" of existing policies and programmes to make them relevant and robust.);
- lack of awareness of the extent of the problem, and in particular lack of awareness of possible actions that could be taken (This lack of awareness exists at all levels, from national-level policy makers to sectoral and local-level officials, as well as among civil society and the most vulnerable communities themselves. Awareness raising is therefore clearly a major area of initial action to be prioritised.);
- lack of incorporation of climate change impacts when developing policies, plans and programmes in some of the most climate sensitive sectors (e.g. water management, agriculture, disaster management, etc.) (Although the need for such integration is being slowly realised, actual integration in the planning, design and implementation of policies needs to be accelerated considerably.);
- lack of adequate tools, knowledge and methodologies to provide guidance and advice to decision makers (This is equally applicable at the technical level in different sectors, including water management, but also at the grassroots levels in the vulnerable communities themselves. Generating sound knowledge, data, methodologies and tools, and then disseminating them, thus need to be important activities in the short term.);
- lack of private sector involvement in issues related to climate change;
- limited understanding of concrete best practices/activities in terms of climate change adaptation; and
- weak monitoring and evaluation plans, including environmental impact assessments, and a lack of best practices and standards that consider climate change implications and climate as a non-static element. Current efforts to address the problem of climate change are more reactive than futuristic.

## Toward strategies for adaptation to climate change in Arab countries

Since climate change is so pervasive and may have an impact on all economic activities, it is clear that everyone is potentially involved in the development and implementation of adaptation measures. Thus a first question is: Who adapts? If adaptation is left to everyone the probability is that it will be left to no one. The more pertinent question therefore concerns the distribution of responsibility for adaptation.

To develop a comprehensive national action programme on climate change (NAPCC) in Arab countries, the following points should be considered:

1) The future NAPCC should be not only aimed at meeting UNFCCC obligations, but also at setting priorities for action and integrating climate change concerns into other national and sectoral development plans and programmes.
2) During the development of the NAPCC, lessons learned from past climate change and environmental planning efforts should be considered. These include:
   - integration with other development plans and programmes and measures that have multiple benefits;
   - the involvement of key governmental and non-governmental stakeholders;

- a practical orientation;
- flexibility that allows the plan to be regularly updated in order to reflect changing circumstances; and
- a high level of awareness among policymakers and stakeholders on climate change issues.

3) The NAPCC should be developed as an integral part of other national and sectoral action plans and policy documents. The success of the measures and actions that will be identified in the NAPCC will therefore depend directly on the degree of integration of these national and sectoral development and action documents.

Climate change concerns and problems are not reflected directly in these policy documents. However, some of them include climate change matters. In the absence of such climate change–related issues in a policy document, these issues should be taken into account in implementing activities under these programmes or plans. Existing environmental regulations, sectoral development policy documents, and other related laws need to be amended if this is required for adaptation or mitigation activities.

The passing of new laws or the amendment of existing laws — in particular policy or development programmes or plans guiding different economic sectors — should follow national and sectoral strategies and policies related to climate change concerns.

4) The NAPCC should be based on pre-feasibility studies of climate change impacts, adaptation assessments, GHG inventories and GHG mitigation analyses. The NAPCC should include a set of measures, actions and strategies that enable vulnerable sectors to adapt to potential climate change and mitigate GHG emissions. The underlying philosophy of these measures is that they should not adversely affect economic development and current lifestyles.

5) The implementation strategies in the NAPCC should include institutional arrangements, legislative framework, financial resources, human capacity building, education and public awareness, and research programmes, as well as coordination with other national and sectoral development plans. Existing barriers to implementation should be also identified, as well as possibilities to overcome such barriers. Finally, the programme should consider several adaptation measures for water resources, agriculture, livestock, rangeland, coastal resources and human health, as well as other related sectors.

6) Research activities should focus on the systematic observation and monitoring of the climate system, development of climate scenarios, vulnerability assessment, potential impacts on ecosystems and society, and possible measures to adapt to climate change and mitigate GHG emissions at the national level. A regular update of findings and outputs using the latest scientific knowledge of global climate change problems will be critical. Based on comprehensive studies and analyses, the NAPCC should be revised from time to time in order to facilitate the implementation of country's policy on climate change.

7) It is recommended that a considerable amount of capacity building and institutional strengthening take place. Education and public awareness activities should be organised for decision makers, technical experts, stakeholders, the general public, students and schoolchildren. A regular review of the level of public awareness of climate change will be essential to increase public participation in the GHG mitigation activities. Options for informal education in the field of environmental protection include use of mass media (newspapers, television, radio etc.) and organisation of conferences and workshops for specialists, the general public and the press.

8) Social and economic instruments play increasingly important roles in the successful implementation of the NAPCC. Economic instruments could take a limiting (taxes) or promoting (subsidies etc.)

approach. Limiting measures include pollution tax, input tax, product tax, export taxes, import tariffs, etc. Promoting measures may include subsidies, soft loans, grants, location incentives, subsidised interest, revolving funds, sectoral funds, eco-funds, green funds, tax differentiation or exemption, investment taxes credits, tax relief for environmental equipment or investment, etc. Therefore, it is necessary to establish economic mechanisms and instruments to implement the NAPCC, and to introduce an appropriate legal framework.

9) The availability of funding sources is a prerequisite for the successful implementation of the adaptation and mitigation strategies and projects identified in the NAPCC.

Possible sources of such funding include:

- government funds and resources;
- local and international environmental funds;
- private sector investors;
- the Global Environment Facility (GEF);
- Clean Development Mechanism initiatives; and
- the UNFCCC and Kyoto Protocol Implementation Mechanisms such as Transfer of Technology, etc.

There are currently four different funds for supporting adaptation measures in non-Annex I countries: the Special Climate Change Fund (SCCF) and Least Developed Country Fund (LDCF) under the UNFCC, the Adaptation Fund under the Kyoto Protocol, and the Strategic Priority on Adaptation (SPA) of the Global Environment Facility.

## Conclusions

This study recognises an alarming deficiency in scientific and technological capabilities, as well as in the political will to address and face problems posed by climate change in the Arab region. Not enough scientific facilities exist to study this phenomenon, insufficient funds are allocated to such research, and the studies that have been undertaken still leave gaps to be filled. Climate change mitigation and adaptation need to be integrated into development strategies, and the issues of planning, scientific capacity, stakeholder involvement and public awareness need to be urgently addressed.

# 3. Water Security Action Planning for Sustainable Growth

MENA Water World Café 2016 Background Paper, Working Group 3

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## Water security –A burning issue for the MENA region

As defined by the Global Water Partnership (GWP), water security, at any level from the household to the global, means that every person has access to enough safe water at affordable cost to lead a clean, healthy and productive life, while ensuring that the natural environment is protected and enhanced[1]. The Ministerial Declaration of the World Water Forum II (WWF2), "Water Security in the 21st Century", lists seven main challenges in achieving water security:

1) meeting basic needs;
2) securing food supply;
3) protecting ecosystems;
4) sharing water resources;
5) managing risks;
6) valuing water; and
7) governing water wisely.

The issue of water security — defined as an acceptable level of water-related risks to humans and ecosystems, coupled with the availability of water of sufficient quantity and quality to support livelihoods, national security, human health and ecosystem services — has been the object of increased academic and policy interest over the past decade. In 2009, the World Economic Forum (WEF) prioritised water security as a global risk, stating that "water security is the gossamer that links together the web of food, energy, climate, economic growth, and human security challenges that the world economy faces over the next decades" (World Economic Forum 2009). In 2013, the UN-Water Task Force on Water Security proposed a working definition of water security developed from contributions made by the broad range of organisations, agencies, programmes and institutions that form UN-Water. It aims to capture the dynamic and constantly evolving dimensions of water and water-related issues, offering a holistic outlook for addressing water challenges through the umbrella of water security, and is intended to serve as a starting point for dialogue on water security in the UN system.

Water security arises at two interconnected levels: local/national and regional/international. At the local/national level, the **security of access to the resource is the crucial problem**. Consequently, good water governance appears to be pivotal to achieve water security.

[1] Various definitions of water security have emerged: Grey and Sadoff (2007) define water security as the availability of water of an acceptable quality and quantity for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risk to people, environments and economies. UN-Water defines water security as the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human wellbeing and socioeconomic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability (UN-Water 2013).

## Why are MENA countries vulnerable to water insecurity?

The **Middle East and North Africa (MENA)** is the driest and most water scarce region in the world, and this is increasingly affecting the economic and social development of most countries of the region. The region's population, which comprises 6.3 percent of the world's total, currently uses only 0.7 percent of the world's available freshwater resources. In addition, the MENA region faces other major development challenges. These include a rapidly growing young population, high unemployment rates, and vulnerability to price shocks and climate change. The region also faces political and security challenges, including extremism.

Why is water security particularly important for the MENA region? Firstly, the region as a whole, and most of the countries, are severely exposed to the following threats:

- Water is already scarce in the MENA region, as will be further discussed in the following chapters. The region is exposed to both physical water scarcity (limited access to water, caused by water shortages or unsustainable management/over-abstraction) and socioeconomic scarcity (society's economic inability to develop additional water resources or its social inability to adapt to the conditions imposed by physical scarcity). This scarcity will only grow over time, due to an increasing population, expected economic growth, and the likely impacts of climate change on water availability and demand.
- There is low institutional capacity to manage water resources and water supply services, particularly at the local and community level. Water governance deficiencies in MENA countries include failure to provide sufficient water for poor and marginalised areas, a lack of attention to water legislation and infrastructure, and an inability to balance the competing demands of socioeconomic needs and the environment. This will also be discussed in the following chapters.
- The poverty trap, widely present in the MENA region, further complicates the issue of water security. The need for water security is particularly acute in rural and poor communities. Water is critical for economic growth and social wellbeing, thus improved water governance requires an understanding of the social, economic and institutional links between reducing poverty and ensuring access to safe water.

Secondly, the Fourth Assessment Report of the International Panel on Climate Change projects dramatic changes in climate across the MENA region during this century. Under an average climate change scenario, the MENA region's water shortage will increase fivefold by 2050 — from today's 42 $km^3$ to approximately 200 $km^3$ (World Bank 2012). Drinking water services will become more erratic than they already are. Cities will come to rely more and more on expensive desalination and on emergency supplies brought by tanker or barge. Service outages place stress on expensive water network and distribution infrastructure. In irrigated agriculture, unreliable water services will depress farmers' incomes and lower productivity. The economic and physical dislocations associated with the depletion of aquifers or the unreliability of supplies will increase. All of these developments will have short- and long-term effects on economic growth and poverty and will increasingly put pressure on public budgets (World Bank 2012).

In reaction to the rapid depletion of water resources, the deterioration in water quality, increased water demand, and changes in water endowments that are affecting environmental quality, food security, municipal infrastructure and economic development in most societies of the MENA region, the Regional Environmental Center (REC)[2] is implementing the project "Sustainable Use of Transboundary Water Resources and Water Security Management (WATER SUM)"[3]. The 36-month

[2] http://www.rec.org/

[3] http://www.watersum.rec.org/

project is funded by the Swedish International Development Cooperation Agency (Sida)[4] from April 2014 to April 2017. The overall objective of the project is to promote and enhance sustainable water resources management and to promote a comprehensive and integrated approach to water security and ecosystem services for sustainable development in beneficiary countries in the MENA region in order to help halt the downward spiral of poverty, biodiversity loss and environmental degradation.

The project is divided into two components: Component 1, "Water Resources Management Good Practices and Knowledge Transfer" (Water POrT); and Component 2, "Water and Security" (WaSe). The objective of the Water POrT component is to accelerate the more sustainable use of the region's water resources and to promote a strategic approach to climate change adaptation, while the WaSe component objective is to promote a comprehensive and integrated approach to water security and ecosystem services for sustainable development in eight selected self-governing territories in Jordan and Tunisia[5]. The WaSe component is a part of efforts to combat water scarcity, reduce the threat of conflicts, halt the downward spiral of poverty, biodiversity loss and environmental degradation, and increase overall human well-being within the wider context of ensuring regional peace and stability.

## Water security in the post-2015 development agenda: How can the MENA Water, Growth and Stability Initiative contribute?

Of all our natural resources, water underpins sustainable development as perhaps none other. Food, energy, health, industry, biodiversity — there is no sphere of planetary life or human endeavour untouched by water. Water use has been growing at more than twice the rate of population increase in the last century. A central challenge for sustainable development is how to balance the competing uses of water; ensure that the needs of all — especially of the poor and marginalised — are met; and maintain healthy and diverse ecosystems. It is therefore no surprise that water appears explicitly as a recurring theme in many of the newly established Sustainable Development Goals[6], and the proposed targets that serve as guideposts towards their achievement.

Sustainable water management is a key driver of economic activity, poverty alleviation and health, and a prerequisite for growth and stability. Poor water management, lack of good water governance and limited awareness contribute to water supply vulnerability and water pollution and are a source of conflicts that constrain growth and threaten both security and the water–energy–food–climate nexus. Moreover, water has a crucial role in all dimensions of sustainable development: it is linked to various key global problems and to all human and economic activities. The water goals and targets directly address the development aims of societies, promote human dignity and ensure achievements are sustainable over the long term. Mobilising water is critical within the post-2015 agenda in order to realise economic and social potential.

Water was recognised as a fundamental human right by the UN General Assembly in July 2010 (A-RES-64-292); by the Human Rights Council in September 2010 (HRC Resolution 15-9); by the Arab Charter on Human Rights (which entered into force on March 15, 2008); and by the constitutions of a number of Arab states (Morocco in 2011, Tunisia and Egypt in 2014). This legal recognition guarantees the right of all people to equitable access to safe water as a basic human requirement, while also enhancing public participation in water management.

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[4] Sida contribution ID 52030234

[5] In Jordan, the municipalities of Al-Karak, Jerash, Al Salt and Ajloun. In Tunisia,the Governorate of Beja: Nefza Delegation; Governorate of Zaghouan: BirMchergua Delegation; Governorate of Gabes: Matmata Delegation; and Governorate of Sidi Bouzid: Sidi Ali Ben Aoun Delegation.

[6] "Transforming Our World: The 2030 Agenda for Sustainable Development." Draft resolution referred to the UN summit for the adoption of the post-2015 development agenda by the General Assembly at its 69th session, September 18, 2015. The United Nations has set 17 new Sustainable Development Goals (SDGs) as global guidelines to eradicate extreme poverty by 2030. More at http://www.un.org/sustainabledevelopment/sustainable-development-goals.

In September 2015, heads of state from all around the world gathered in New York to adopt the 2030 Agenda for Sustainable Development, an ambitious "plan of action for people, planet and prosperity", with 17 Sustainable Development Goals (SDGs) and 169 targets, aiming at nothing less than "transforming our world".

The **Water, Growth and Stability conference**, which took place on April 26–28, 2016, in Szentendre, Hungary, co-organised by the Regional Environmental Center for Central and Eastern Europe (REC) and the Ministry of Foreign Affairs and Trade of Hungary as a pre-event to the Budapest Water Summit 2016, constitutes a milestone in the REC WATER SUM project. Following field missions, workshops, trainings and ambassadorial briefings for the MENA region, the conference gathered a broad spectrum of key stakeholders from throughout the MENA region, including representatives of ministries in charge of water management and water security, local authorities, international organisations, NGOs, academia and the business community. Delegates at the Water, Growth and Stability conference launched the **Water, Growth and Stability Initiative (WGSIni)**, a knowledge-based platform; a dynamic network of water experts from the MENA region and Europe; and an e-learning tool for capacity building and the dissemination of lessons learned.

The main objectives of the WGSIni are to:

- support the MENA region and its water stakeholders in advancing water management at national and local level while also shoring up regional cooperation and engagement and identifying viable tools and solutions;
- stimulate the more sustainable use of the region's water resources, stronger cooperation between pivotal actors, and a long-term approach to climate change adaptation;
- promote a comprehensive and integrated approach to water security and ecosystem services and raise awareness of the increasingly interrelated nature of our global resource systems and their impact on water sustainability;
- develop a framework programme within the WGSIni in line with the priorities of countries in the MENA region; and
- mobilise additional resources and partners to expand the established framework steered by the MENA region, and identify synergies with other on-going programmes and initiatives.

The**WGSIni** aims to actively contribute to some of the SDGs, as outlined in Figure 1 and below.


Figure 1: The WGSIni contribution to the SDGs

## SDG 6: Clean water and sanitation

Clean, accessible water for all is an essential part of the world we want to live in. Water is at the core of sustainable development and is critical for socioeconomic development, healthy ecosystems and human survival itself. It is vital for reducing the global burden of disease and improving the health, welfare and productivity of populations. Moreover, it is at the heart of adaptation to climate change, serving as the crucial link between the climate system, human society and the environment. This is why the SDGs cover a wide range of drivers across the three pillars of sustainable development. They also include a dedicated goal on water and sanitation (SDG 6) that sets out to "ensure availability and sustainable management of water and sanitation for all". The **WGSIni** aims to contribute significantly to the achievement of SDG 6 through actions targeting the achievement of universal and equitable access to safe and affordable drinking water, as well as access to adequate and equitable sanitation and hygiene for all, paying special attention to the needs of women, girls and others in vulnerable situations; improve water quality; increase water-use efficiency; implement integrated water resources management at all levels; and protect and restore water-related ecosystems. Moreover, the **WGSIni** directly supports the achievement of SDG 6 through the expansion of international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes.

## SDG 11: Sustainable cities and communities

Half of humanity — 3.5 billion people — live in cities today. The sustainable, efficient and equitable management of water in cities has never been as important as in today's world, and especially in MENA countries. Making cities and communities inclusive, safe, resilient and sustainable means ensuring access to safe and affordable housing, and upgrading slum settlements. It also involves improving

urban planning and management in ways that are both participatory and inclusive. Two main challenges related to water are affecting the sustainability of human urban settlements: the lack of access to safe water and sanitation, and increasing water-related disasters such as floods and droughts. Those who suffer most from these water-related challenges are the urban poor. The **WGSIni** contributes to the achievement of SDG 11 through the empowerment of local communities and cities in MENA countries for better local water security planning and the active involvement of local stakeholders in the planning process. The participatory local water security planning methodology, developed as a part of the initiative, will build the capacities of MENA cities and help them to become more resilient and sustainable in regard to water security.

### SDG 12: Responsible consumption and production

Sustainable consumption and production is about promoting resource and energy efficiency and sustainable infrastructure, and providing access to basic services and a better quality of life for all. Currently, the excessive use of water is contributing to global water stress, and this is particularly the case in MENA countries. In the absence of any change in consumption patterns, by 2030 the shortfall between the demand for, and supply of, water is projected to be 40 percent. This being the case, SDG 12 promotes sustainable consumption and production patterns, including the efficient management of water as the most important natural resource. The **WGSIni** contributes to the achievement of SDG 12 through the establishment of an open platform for discussion about water efficiency and sustainable infrastructure for access to water, while trying to involve all important stakeholders from the public sector (national and local levels), civil society and the business community.

### SDG 3: Good health and well-being

Recognising the interdependence of health and development, SDG 3 aspires to ensure health and well-being for all, to achieve universal health coverage, and to provide access to safe and effective medicines and vaccines for all. Water, sanitation and hygiene (WaSH) interventions have been described as “critical determinants of health” that prevent the fecal-oral transmission of pathogens, while hygiene promotion has been identified as having one of the greatest cost-benefit ratios of disease control interventions. Having been developed as a result of local needs and aspirations, and in line with national water priorities in selected MENA countries, the **WGSIni** aims to contribute significantly to water-related health and well-being goals through various capacity-building measures and through the direct involvement of local communities in setting objectives and water security planning.

### SDG 8: Decent work and economic growth

Water has always played a key role in economic development, and economic development has always been accompanied by water development. Most of this growth will happen in developing countries (like most MENA countries) that have limited capacity to deal with this rapid change; and growth will also lead to an increase in the number of people living in slums, which often have very poor living conditions, including inadequate water and sanitation facilities. Therefore, the development of water resources for economic growth, social equity and environmental sustainability will be closely linked with sustainable development. As formulated in SDG 8, water shall promote “sustained, inclusive and sustainable growth” in an equitable and reasonable manner, thus contributing to poverty reduction and to narrowing the gap between rich and poor everywhere. The **WGSIni** will place a special emphasis on water security as an enabler for sustainable growth by supporting MENA governments and local communities in water security planning and integrated water management through open dialogue between stakeholders.

### SDG 13: Climate action

Climate change will compound pressures on resources. Furthermore, these pressures will be unevenly distributed around the world, with the greatest impacts occurring in populations and locations characterised by low resilience. Water is the primary medium through which climate change influences Earth’s ecosystems and thus livelihoods and the well-being of societies. Strengthening resilience and

the adaptive capacities of more vulnerable regions, such as the MENA region, must go hand in hand with efforts to raise awareness and integrate measures into national and local policies and strategies. Adaptation to climate change is urgent, and water plays a pivotal role in such efforts. To recognise this reality and to respond accordingly presents development opportunities for the MENA region, and the **WGSIni** aims to emphasise climate action as one of the most important needs for developmental planning in the region, at both the national and local level.

### SDG 16: Peace, justice and strong institutions

Goal 16 is dedicated to promoting peaceful and inclusive societies for sustainable development, providing access to justice for all, and building effective, accountable institutions at all levels. Important targets within this SDG are to develop effective, accountable and transparent institutions at all levels, to ensure public access to information, and to protect fundamental freedoms. This means that water security–related actions in the region should be based on strong institutions and institutional support, and also that bottom-up empowerment should be fostered, including support for home-grown institutions and reformers and facilitators of carefully planned decentralisation. This is why the **WGSIni** aims to empower national and local governments in MENA countries, civil society, and particularly women's grassroots organisations.

### SDG 5: Gender equality

Empowering women and promoting gender equality is crucial to accelerating sustainable development. It has become increasingly accepted that women should play an important role in water management and that this role could be enhanced through the strategy of gender mainstreaming. Understanding gender roles, relations and inequalities can help explain the choices people make and their different options. Involving both women and men in integrated water resources initiatives can increase project effectiveness and efficiency. The **WGSIni** puts special emphasis on gender issues in water security and will provide a particular forum for women's grassroots organisations to discuss water issues and to assist local communities in water security planning and national governments in integrated water management planning and implementation.

## Local water security action plans – A way to move forward in MENA countries

Local water security action planning has been given a pivotal place in the WGSIni. Why local water security? At the local level, water insecurity — either water scarcity or low water quality — may lead to political instability or conflict, often exacerbated by attempts at profiteering through private uncontrolled sales of water. Threats to water resources or ecosystems can further aggravate these conditions[7]. To achieve water security, good water governance is essential. It requires capable institutions supported by well-developed legislative and policy instruments. However, the implementation of any policy in the field of poverty reduction, sustainable development and the conservation of biodiversity is impossible without the active participation and ownership of local communities and local governments along with the help of their strategic partners (such as national authorities, CSOs and businesses). Local water governance is therefore an essential element of overall good water governance.

We trust that local water governance can be improved through initiating and supporting the process of developing local water security action plans (LWSAPs) that mirror national/regional/international policy priorities, but address water security issues at local level as a precondition for the well-being of local populations. The development of LWSAPs also ensures the application of an integrated approach to water management as a means of enhancing water security, showcasing the direct and tangible results of supporting water-related dialogue and capacity building. On the other hand, the implementation of measures for achieving water security locally can have important impacts regionally, particularly for downstream users.

[7] Water Security & the Global Water Agenda - A UN-Water Analytical Brief. United Nations University, 2013

A focus on local water security contributes to improving water access for local populations. It is important to mention that this is not water security for all water users. For example, it does not focus on the large-scale irrigation network, or on the energy-producing sector. Nor is it a framework for comprehensive national water security that should focus on all water users. Although the LWSAP focus is on the provision of water for the local population (e.g. the municipality), it acknowledges that other water users are important and that their needs are interlinked with local ones.

The LWSAP process in Jordan and Tunisia was designed to comprise two interrelated steps: an assessment of the current status of water security; and the development of a management or action plan. The planning methodology, described in the publication "Local Water Security Action Planning Manual" (Laušević et al. 2016)[8], applied elements from two assessment methodologies: Water Security Status Indicators (WSSI); and the Canadian Water Sustainability Index (CWSI). The manual is a step-by-step guidebook for practitioners who are developing LWSAPs in local communities. The authors have compiled an original methodology comprising seven interrelated activities covering stakeholder analysis, public opinion assessment, local water security assessment, and problem analysis and prioritisation. Each of the seven activities comprises two or more steps, making a total of 20 steps in the LWSAP process. All 20 steps, and the deliverables related to each one, are described in detail in the manual.


## The local water security planning process in Jordan and Tunisia – Experience so far

The LWSAP process in eight local governments in Jordan and Tunisia, based on the methodology drafted in the manual, was initiated in early 2016. Currently, the process is approaching the final phase and the majority of pilot local governments have developed a draft action plan. Although it is still early to perform a final evaluation of the pilot process, some observations can be made.

[8] http://documents.rec.org/publications/LWSAP_Manual_April2016.pdf

Firstly, there is no doubt that local water security planning, based on the LWSAP methodology provided, is considered as an indispensable process for municipalities in the region, particularly those included in the project. Currently, the necessity of using such a methodology for action planning at the local level is not under question: rather, the discussion is about the details of the methodological approach, including improvements.

When it comes to the planning process itself, there is a general problem with a lack of reliable data due to the costs involved in collecting such information. Action planning processes at the local level in the region emerge as extremely time-consuming, particularly the situation analysis, due to the lack of reliable data and skills for data acquisition and analysis. As a result, some strategic planning exercises ran short of time, and sometimes the results of the planning process were not successful. In some cases, the entire planning logic was modified and some steps were not even performed, due to the limited timeframe for planning foreseen by the donor assistance programme.

Measuring development at a local level and monitoring development progress are increasingly being viewed as fundamental to any successful development initiative. However, one major problem is the lack of reliable and pertinent data and its systematic management, processing and updating.

The success of the local planning processes was in direct correlation with the administrative level and the internal capacity of the local government to engage stakeholders for the entire process. Local communities in the region are different, with different expertise and human resources. However, the role of facilitators was very important in every community: it was their task to move things forward and to make sure that a plan was produced and that deadlines were met.

Planning exercises were based on classic participatory planning methodology. However, public interest in participating in local water security planning is still limited, despite recent positive examples in this regard. While citizen participation in local policy making has been encouraged and practised in the majority of strategic planning processes in the region, the notion of fostering local water partnerships, which engage public, social, economic, environmental and civic stakeholders in the effective joint realisation of development priorities as identified within local strategies, is still to be further strengthened.

A common understanding of the necessity for a strategic approach and of the methodology provided had an effect on only limited and sporadic administrative problems during the planning processes, particularly in the early phase. However, the main challenge was to design the process as visible and attractive for the community, and, in particular, to maintain the motivation for work and “tensions” inside working groups during the long-term process — as strategy formulation and implementation should be.

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The present background document comprises three articles prepared by experts to address the topics of three World Café 2016 working groups: Governing water for sustainable growth (Group 1); Water-related climate change mitigation and adaptation measures for sustainable growth (Group 2); and Water security action planning for sustainable growth (Group 3).

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