

# Adaptation to a Changing Climate in the Arab Countries



MENA DEVELOPMENT REPORT

**OVERVIEW AND TECHNICAL SUMMARY**

# Adaptation to a Changing Climate in the Arab Countries

A Case for Adaptation Governance and Leadership in  
Building Climate Resilience

Dorte Verner, Editor



**THE WORLD BANK**  
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# Preface

The governments of Arab countries have, on various occasions, requested World Bank assistance to provide analytical and technical inputs that address the critical challenges facing development in a changing climate. Based on these requests, the World Bank is producing this flagship report in partnership with the League of Arab States (LAS) with the objective of providing information on climate change in the Arab region, as well as technical guidance on how to adapt to climate change.

This report serves as an umbrella for addressing climate change in the Middle East and North Africa (MENA) region. This task has three phases: Phase I is this regional flagship study on climate change adaptation in the Arab countries. In Phase II it is proposed that a selected number of country-specific climate change strategies for client governments in the region (on an on-demand basis) be initiated. Additional regional research may be needed because the task in Phase I could not cover the many areas related to climate change. In Phase III, a number of lending operations would be prepared relating to climate change adaptation and new technology in Arab countries in the areas identified as priorities in Phases I and II. The Bank is already providing funding to MENA countries through ongoing technical assistance and lending operations and the Climate Investment Fund.

**Participatory process:** This report, produced by the World Bank in partnership with LAS, had inputs from partners in Arab countries, including researchers, institutions, nongovernmental organizations (NGOs), and advisers:

- Researchers in Arab countries did considerable background work and were heavily involved in preparing papers and discussions of issues and opportunities.

- The documents were posted on the web and on social media sites, which enabled the community at large to contribute and comment.
- The governments of Arab countries were invited to comment and contribute to the report as it was being drafted.
- As part of this task a climate change network is being created.

**Scope:** The scope of this report was agreed to and endorsed by: (i) LAS and regional researchers in July 2010, and (ii) Ministries of Environment in Arab countries at the Joint Committee on Environment and Development in the Arab Region (JCEDAR) meeting in October 2010.

The report and background documents are expected to provide input to the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report scheduled for 2013–14, which could lead to a comprehensive treatment of the Arab countries in that document. In addition, seven IPCC leading and coordinating authors are on this report's team and advisory panel.

This report and its associated activities are directed primarily to decision makers in Arab countries in order to support and guide their efforts to adapt to the challenges of climate change.

### Work process

- **The first workshop** was held January 2011 in Lebanon. The lead authors and advisers identified links between the topic areas, agreed upon a coordinated framework, and developed an annotated outline of the background paper for each chapter.
- **A zero draft** of the chapters was provided by the lead authors by April 1, 2011, and was posted on the web for public review and comments. A number of contributing authors were selected, based on their substantial comments and suggestions, and were invited to collaborate as co-authors of the paper and to participate in the second workshop.
- **The second workshop** was a writing workshop held in the Marseille Centre in June 2011. The lead authors, IPCC experts, and other contributing authors compiled a first draft using inputs from the zero draft.
- **The World Bank Quality Enhancement Review** was held October 4, 2011, and the resulting draft report was then circulated by LAS to all member governments for comments, and then placed on the web for wider input.
- **Regional presentations and consultations** on the report were held between October 2011 and January 2012. This provided an opportu-

nity for the team to receive guidance from government officials, NGOs, and the private sector, based on their knowledge and experience. Consultations were hosted by LAS/JCEDAR (Arab Republic of Egypt), Amman Institute for Urban Development/Greater Amman Municipality (Jordan), Ministry of the Environment/United Nations Development Programme (UNDP)/Issam Fares Institute at the American University of Beirut (Lebanon), Arab Forum for Environment and Development Annual Conference (Lebanon), African Development Bank (Tunisia), Ministries of Finance and Environment (United Arab Emirates), and Ministry of Environment (Algeria). Additional presentations were hosted by the Arab Water Council at the Second Arab Water Forum (Egypt); International Food Policy Research Institute (IFPRI) and Economic and Social Commission for Western Asia (ESCWA) at the Arab Food Security Conference (Lebanon); International Conference on Adaptation to Climate Change and Food Security in West Asia and North Africa (Kuwait); and finally, the Lebanese Ministry of Environment at the United Nations Framework Convention on Climate Change (UNFCCC) COP17 (South Africa).

- **The third workshop** was a writing workshop held in Tunisia, in January 2012. The lead authors and regional experts finalized the chapters and included the comments provided by the governments of Arab countries and other reviewers.
- **A World Bank Decision Meeting** was held in March 2012; the resulting report was finalized after additional consultations in Lebanon and Jordan in May 2012.
- **The report will be available in print and online at [www.worldbank.org/publications](http://www.worldbank.org/publications).**
- In addition to this report, **a climate change portal** is being developed that will provide climate profiles for each of the Arab countries. Arab countries have been involved at every level of this project, from the lead authors and the research community contributing to the report, to the various consultations and workshops with climate change adaptation specialists from Arab countries. Throughout this process, the authors and advisers have essentially become a community of practice for adaptation to climate change in the region.

The team is grateful for the financial support from the European Union, the Italian Development Corporation, and the International Fund for Agricultural Development (IFAD), in addition to that of the League of Arab States and the World Bank.



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# Overview

## Climate has shaped the cultures of Arab countries

**The first settlements in the world—farming communities and cities—began in this region, and all of them have changed in response to the variable climate.** For thousands of years, the people of this region have coped with the challenges of climate variability by adapting their survival strategies to changes in rainfall and temperature. But the message is clear: over the next century this variability will increase and the climate of Arab countries will experience unprecedented extremes. Temperatures will reach new highs, and in most places there will be less rainfall. Water availability will be reduced, and with a growing population, the already water-scarce region may not have sufficient supplies to irrigate crops, support industry, or provide drinking water.

**Fortunately, Arab countries can take steps to reduce climate change impacts and build resilience.** In many cases, climate change is bringing attention to issues that were overlooked before. For example, low quality urban drainage systems have contributed to flooding in some Arab cities, and the threat of more flooding from climate change could be the impetus needed to finally improve this infrastructure. In rural areas, climate change is forcing communities to rethink long-standing gender roles that have perpetuated gender inequality. As a result, climate change presents many opportunities, not only to reduce vulnerability, but also to contribute to greater long-term development.

**Climate change is happening now in the Arab countries.** The Arab people and policy makers already experience the effects of a changing climate; higher temperatures and extreme events such as drought and flash floods have become the new norm. The year 2010 was the warmest since the late 1800s, when this data began to be collected, with 19 countries setting new national temperature highs. Five of these were Arab countries, including Kuwait, which set a record high of 52.6 °C in 2010, only to be followed by 53.5 °C in 2011. Extreme climate events are widely reported in local media, and a 2009 Arab region survey showed that over

90 percent of the people sampled agree that climate change is occurring and is largely due to human activities; 84 percent believe it is a serious challenge for their countries; and respondents were evenly split on whether their governments were acting appropriately to address climate change issues. The sample came mostly from the better-educated population, but it shows that there is a firm base and desire for action regarding climate change across the Arab region.

**Water scarcity will increasingly be a challenge in the Arab countries.** The Arab region has the lowest freshwater resource endowment in the world. All but six Arab countries (the Comoros, Iraq, Lebanon, Somalia, Sudan, and the Syrian Arab Republic) suffer from water scarcity, which is defined as having less than 1,000 m<sup>3</sup> of water per person per year. It is estimated that climate change will reduce water runoff by 10 percent by 2050. Currently, the region suffers a water deficit (demand is greater than supply), and with increasing populations and per capita water use, demand is projected to increase further, by 60 percent, by 2045.

**Climate change will likely reduce agriculture production in Arab countries.** Projections suggest that the rate of increase in agricultural production will slow over the next few decades, and it may start to decline after about 2050. Most of the Mediterranean region, which supports 80 percent of production, is projected to have less rainfall and hotter conditions. This will increase water use and likely limit the productivity of some crops. Other areas, such as the Nile Delta, will have to contend with saline intrusion from the sea. Farmers will face additional problems from higher temperatures. For example, the chilling requirements for some fruits may not be met; new pests will emerge; and soil fertility is likely to decline. This is alarming because almost half of the Arab region's population lives in rural areas, and 40 percent of employment is derived from agriculture. Compounding this vulnerability are troubling poverty rates: 34 percent of the rural population is poor, and unemployment is high, especially for women and youth.

**Urban populations are rapidly growing.** Currently 56 percent of Arab people live in urban centers, and by 2050 these populations will increase to 75 percent. Droughts have been shown to increase rural-to-urban migration in the region. A recent multi-year drought in the Syrian Arab Republic is estimated to have led to the migration of about one million people to informal settlements around the major cities. Many cities are already experiencing severe housing shortages because of this urban population growth.

**Urban areas are vulnerable to climate change.** Flash flooding is increasing in cities across the region as a result of more intense rainfall events, concrete surfaces that do not absorb water, inadequate and blocked drainage systems, and increased construction in low-lying areas and

*wadis*. The number of people affected by flash floods has doubled over the last ten years to 500,000 people across the region. Climate change projections suggest that average temperatures in the Arab countries are likely to increase by up to 3°C by 2050. The urban heat island effect is projected to increase nighttime temperatures by an additional 3°C. In addition, providing water to urban areas is becoming increasingly difficult. Reasons for this include aging pipes, water loss from leakage of 40 percent or more in some major cities, and no water infrastructure in informal settlements.

**Climate change threatens the tourism sector—an important source of revenue and jobs.** Tourism today contributes about US\$50 billion per year to the Arab region, which is about 3 percent of its total gross domestic product (GDP), and tourism is projected to grow by about 3.3 percent per year for the next 20 years. It is also an important sector for jobs, because roughly 6 percent of the region's employment is tourism related. Higher temperatures are an obvious threat to tourism in a region that is already regarded as hot. Analyses of tourism patterns suggest that in the long-term, destinations on the north Mediterranean coast or within Europe will become more attractive than will the Arab region. Snowfall in Lebanon (for skiing), Red Sea coral reefs, and many ancient monuments across the region are threatened by climate change and severe weather. Ecotourism is an expanding sector, but the ecosystems (coral reefs, mountains, and oases) on which it depends will have to be managed carefully as they adjust to a changing climate. Extreme events, such as heavy rains, or more chronic pressures, such as increased salinity in groundwater, can threaten the region's historic buildings, paintings, and artifacts. Some destinations, such as Alexandria, will be further threatened by seawater inundation as sea levels rise. In most cases, there is already a need to better conserve and protect these cultural sites. Climate change increases its urgency.

**Climate change threatens progress to achieve gender equity in the Arab region.** Men and women possess unique vulnerabilities to climate change impacts, largely based on their respective roles in society. However, in the majority of cases, rural women tend to be vulnerable in more ways than are rural men. Climate change will further affect rural livelihoods, and more men will feel obligated to move to cities to seek paid employment, which is mostly unskilled and temporary, with little security, low wages, crowded living conditions, and poor health support. As a result, on top of their already heavy workload of domestic tasks and local natural resource management, rural women assume the departed male's community role, but with additional challenges. Women tend to have less education; they find travel difficult because of cultural norms, pregnancy, and child care; and women often lack the cultural and legal authority to assert their rights. For example, their access to credit might be limited,

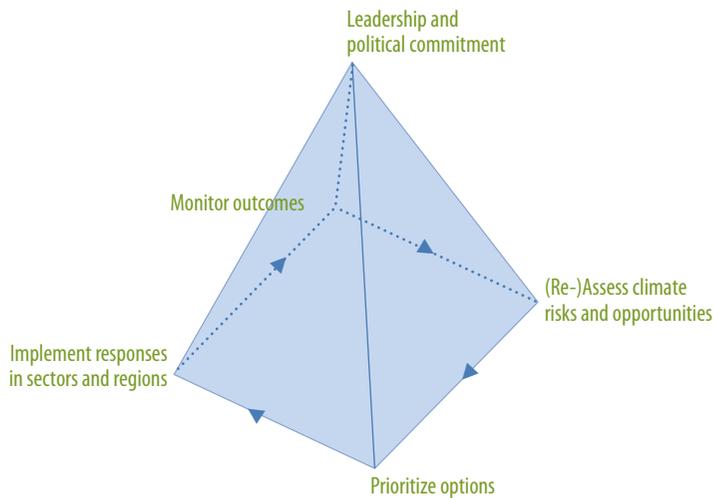
access to and control of water is usually ceded to the landowner—rarely a woman—and even access to rural organizations and support systems is often thwarted. Women’s representation in Arab governments is only 9 percent, or half of the global average.

**Women are active agents of adaptation.** Because of their central role in family, household, and rural activities, women are in a position to change the attitudes, behaviors, and livelihoods that are needed for successful adaptation. A focus on gender is not an add-on to policy formulation but an essential part of any development strategy. Effective adaptation can only be achieved if the many barriers to gender equity are removed and, in particular, women are empowered to contribute. While women still have a literacy rate 15 percent lower than men and little voice in decision making, there is evidence that this is changing. For example, in some Gulf countries, more women than men graduate from universities.

**The impacts of climate change on human health are varied and often indirect.** Higher temperatures are known to lead directly to increased morbidity (deaths) through heat stress and indirectly to strokes and heart-related deaths. Warmer conditions also affect the geographic range of disease vectors, such as mosquitoes. A warmer climate will expose new human populations to diseases, such as malaria and dengue, for which they are unprepared. In the Arab region, disruptions to existing agricultural practices will lead to more widespread malnutrition, because of higher food prices and greater exposure to diseases and other health problems—especially if greater migration to unsanitary, informal settlements is triggered. The impacts of malnutrition on children are particularly troublesome because they lead not only to increased child mortality, but also to developmental and long-term physical and mental impediments.

**While experts agree on climatic trends, the socioeconomic impacts of climate change will vary from country to country.** These impacts largely depend on a country’s coping capacity, which is often linked with its level of development. The diverse Arab region includes six least developed countries (LDCs) with predominantly rural populations and an annual per capita GDP as low as US\$600 (Somalia). By comparison, the GDP in Kuwait, Qatar, and the United Arab Emirates is more than US\$50,000 per capita annually, with 80–90 percent of the people living in cities. It is likely that all economies will be increasingly affected by climate change as time passes, but it is clear that some countries will be affected more than others. Wealthier or more diverse economies are more resilient to climate change than the poorer or less diverse economies, where many people live off the land and remain among the most vulnerable to negative climate impacts. This is illustrated by background case studies prepared for this report on income, livelihoods, well-being,

FIGURE 1

**The Adaptation Pyramid: A framework for action on climate change adaptation**

Source: Authors.

and poverty in Syria, Tunisia, and the Republic of Yemen. Nevertheless, results show that over the next 30–40 years, climate change is likely to lead to a cumulative reduction in household incomes of about 7 percent in Syria and Tunisia, and 24 percent in the Republic of Yemen.

**Arab countries can take action to reduce their vulnerability to climate change.** For example, this report proposes an Adaptation Pyramid (figure 1) framework that assists stakeholders in Arab countries in integrating climate risks and opportunities into development activities. It is based on an adaptive management approach, but it also highlights the importance of leadership, without which adaptation efforts are unlikely to achieve the necessary commitment to be successful. The framework begins by assessing climate risks and opportunities and identifying options within the context of other development planning. The next step is to identify and prioritize adaptation options within the context of national, regional, and local priorities. Finally, adaptation responses will be implemented and outcomes monitored over time. It is important to take into account the long-term consequences of these decisions, because short-term responses may not be efficient or could lead to maladaptive outcomes. An effective approach for prioritizing options is “robust decision making,” which identifies choices that lead to acceptable outcomes under many future scenarios. This approach is particularly well suited to climate change, a problem that will be constantly evolving in the coming decades and will require many options during multiple iterations of decision mak-

ing. The risk of policy errors is present when dealing with climate change, but a robust decision making process reduces risk. Other important measures for Arab region policy makers to implement are discussed below.

1. **Facilitate the development of publicly accessible and reliable information related to climate change.** Access to quality weather and climate data is essential for policy making. Without reliable data on temperature and precipitation levels, it is difficult to assess the current climate and make reliable weather forecasts and climate predictions. For example, information on river flows, groundwater levels, and water quality and salinity is critical for assessing current and future water availability. However, climate stations across most of the Arab region are very limited compared to most other parts of the world and what data exists is often not digitized or publicly available. Conflict in parts of the region disrupts both the collection and sharing of data. Information on food production and the main food supply chains (such as changes in agricultural yields and production for important crops, forage, and livestock) needs to be linked with weather and water data to better monitor and understand the effects of a changing climate. In addition, socioeconomic data (including household and census data) and other economic data related to the labor market and production should be collected and made available.
2. **Build climate resilience through social protection and other measures.** Resilience is determined by factors such as an individual's age, gender, and health status, or a household's asset base and degree of integration with the market economy. Underinvestment in social safety nets—public services such as water supply and wastewater treatment, and housing and infrastructure—make people more vulnerable to a changing climate. Further, there should be measures in place to ensure equitable access to health care and a quality education. Such social protection measures include insurance schemes, pensions, access to credit, cash transfer programs, relocation programs, and other forms of social assistance. These investments and instruments facilitate economic and social inclusion, which creates co-benefits between adaptation and development goals.
3. **Develop a supportive policy and institutional framework for adaptation.** Basic conditions for effective development such as the rule of law, transparency and accountability, participatory decision-making structures, and reliable public service delivery that meets international quality standards are conducive to effective development and adaptation action. In addition, climate change adaptation requires new or revised climate-smart policies and structures at all levels.

**Sound adaptation planning, strong governmental/nongovernmental cooperation, and plentiful financial resources are all important for building resilience to climate change.** Developing national adaptation strategies are important for prioritizing adaptation activities that respond to urgent and immediate needs, and for setting forth guiding principals in the effort to cope with climate change. National governments have a key role in developing these strategies and as a result play an important role in promoting collaboration and cooperation. This cooperation should include the government, civil society, the private sector, and international institutions. Within governments, inter-ministerial coordination is especially critical, because adaptation responses often require activities involving multiple ministries and sectors. Finally, to do any of the activities above it is important to secure the necessary financial resources. There are many sources for adaptation funding, but first the Arab countries will need to build their capacity to analyze their financial needs and generate and manage these resources.

**The Arab region's climate has already begun to change, often to the detriment of Arab society.** But what makes climate change particularly difficult is that it is not a static problem; a more variable and unpredictable climate will not be solved by one round of policy making. By nature, then, adaptation governance will be a dynamic process of multiple iterations in response to new threats. Political change, including changes originating from the Arab spring, can provide an opportunity to strengthen civil society participation in adaptation governance and enable the move toward a more inclusive approach to addressing climate change issues and building climate resilience.

**This report is about climate change, its impacts on people and on the systems on which we depend, and how we might adapt to it.** The text highlights a number of issues and areas that are being affected by climate change. One important message of the report is that climate change should be taken into account in all activities, including those not addressed in this report. Anticipation of climate change can be the stimulus for improving interventions, galvanizing support, and improving governance.

**This report can be used as a road map moving forward.** This report seeks to provide, for the first time, a coherent assessment of the implications of climate change to the Arab region and the resultant risks, opportunities, and actions needed. The information highlighted within explains the potential impacts of climate change and the adaptation responses needed in key sectors and thematic areas, such as water, agriculture, tourism, gender and health, as well as in urban and rural settings. The report attempts to advance the discussion by providing adaptation guidance to policy makers in Arab countries. It does this in three ways.

First, it proposes the Adaptation Pyramid Framework on how to move forward on this agenda. Second, it presents a typology of policy approaches relevant to the region, which would facilitate effective policy responses by decision makers. Third, a matrix is provided, which outlines key policy recommendations from each of the chapters.

# Technical Summary

## Climate change as a development challenge: A harsh environment has shaped the cultures in the Arab region

Climate change is a defining element of today's development challenges. In Arab countries and across the globe, climate change is already damaging people's livelihoods and well-being. It is a threat to poverty reduction and economic growth, and it may unravel many of the development gains made in recent decades. Both now and over the long run, climate variability and change threaten development by restricting the fulfillment of human potential and disempowering people and communities, constraining their ability to protect and enrich their livelihoods.

Climate has shaped the cultures of Arab countries. For thousands of years, people of the region have coped with the challenges of climate variability by adapting their survival strategies to changes in rainfall and temperature. But the message is clear: Over the next century this variability will increase and the climate of Arab countries will experience unprecedented extremes. Temperatures will continue to reach record highs, and in many places there will be less rainfall. Water availability will be reduced, and with a growing population the already water-scarce region may not have sufficient supplies to irrigate crops, support industry, and provide drinking water. Climate change will not only challenge the status quo: It will threaten the basic pillars of development.

Many climate adaptation strategies that people have used throughout history are now less viable. Around 2200 BC, a temporary climate shift created 300 years of reduced rainfall and colder temperatures, which forced people to abandon their rainfed fields in what is now the northeast section of the Syrian Arab Republic. Today, despite technological gains, the ability of climate-affected people to migrate in the face of these challenges is limited in part to national borders and nontransferable property rights. Often the only choice left for people faced with depleted assets and less productive livelihoods in drought-stricken areas is to move to cities or towns—areas where their rural skills are hard to deploy. This was the

case for the Tuaregs in southern Algeria during the prolonged drought of the 1970s, and in the past decade for the Bedouins in Syria.

Climate change is happening now in the Arab countries. The Arab people and their policy makers already experience the effects of a changing climate: higher temperatures and extreme events such as drought and flash floods have become the new norm. Climate change is superimposed on the pre-existing risks and vulnerabilities that poor and marginalized groups typically face. It has, or soon will, affect most of the 340 million people in the Arab region. But the roughly 100 million poor people who have the fewest resources at their disposal to adapt are the least resilient to the impacts of these changes. Climate change is a threat to short-, medium-, and long-term development, and it restricts human potential and agency by reducing the ability of people to make informed choices regarding their well-being and livelihoods. Many studies have suggested that the poor are the most vulnerable to climate change for such reasons as:

- A dependence on natural resources that are exposed to the climate;
- A lack of assets, which hinders effective adaptation;
- Settlements in at-risk areas, which are less productive and are vulnerable to floods, droughts, or other severe events;
- Migrant status, which can prevent them from accessing certain social services;
- Low levels of education, which prevent them from developing more climate resilient skills or livelihood strategies; and
- Minority status, which deters policy makers from making them the focus of adaptation policies.

While experts agree on climatic trends, the socioeconomic impacts of climate change will vary from country to country. This largely depends on a country's coping capacity, which often is linked with its level of development. The Arab region varies greatly in climate, culture, education, literacy, resource endowments, and thus in vulnerability. It includes six LDC countries with per capita GDP as low as approximately US\$600 (Somalia). With the exception of Djibouti, these poor countries have rural populations of over 50 percent and agricultural sectors that contribute to approximately 20 percent or more of total GDP. By comparison, the GDPs of Kuwait, Qatar, and the United Arab Emirates are more than US\$50,000 per capita, with 80–90 percent of the people living in cities. Literacy rates of adult women in Morocco and the Republic of Yemen are below 50 percent; whereas in Lebanon and Libya, more than 50 percent of young women are enrolled in tertiary education—more than young men from the same countries.

It is likely that all economies will be increasingly affected by climate change as time passes, but it is clear that some countries will be hurt more than others. Wealthier or more diverse economies will exhibit more climate resilience than will poorer or less diverse economies, where many people live off the land and remain among the most vulnerable to negative climate impacts. This is illustrated by background case studies prepared for this report on income, livelihoods, well-being, and poverty in Syria, Tunisia, and the Republic of Yemen (see below).

There is increasing evidence that climate change will have severe negative impacts on the economic and social development of Arab countries. Yet research on the socioeconomic dimensions of climate change in the Arab region is only in its early stages, with the report from the Arab Forum for Environment and Development (AFED) being among the most comprehensive. (Tolba and Saab 2009). There exist a number of studies of recent climate trends and future climate projections for the Arab region, but no single document that brings them all together. Most assessments, such as the Intergovernmental Panel on Climate Change (IPCC), split the Arab region between Africa and Asia. This report seeks to provide, for the first time, a coherent assessment of climate change in the Arab region.

This report also serves as a tool to begin to assess climate risks, opportunities, and actions to be taken. The information highlighted within explains the potential impacts of climate change in key sectors such as water, agriculture, tourism, gender and health, as well as in urban and rural settings. The report goes on to discuss possible policy options for reducing human vulnerability and for better adapting to climate variability and change. It attempts to advance the discussion further by providing guidance to policy makers in Arab countries. It does this in three ways. First, it provides a Framework for Action on Climate Change Adaptation, represented by an adaptation pyramid (see figure TS.10), on how to move forward on this agenda. Second, it presents a typology of policy approaches relevant to the region, which would facilitate effective policy responses by decision makers. Third, a policy matrix is provided that outlines key policy recommendations from each of the chapters.

### **Climate change is already being felt in Arab countries**

Nineteen countries in the world set new national temperature highs in 2010, the warmest year since record keeping began in the late 1800s; five of these were Arab countries. Kuwait set a record high of 52.6°C that year, only to see 53.5°C in 2011. Such events have registered with the Arab people. A 2009 Arab region survey showed that over 90 percent of the people sampled agree that climate change is occurring and that it is

largely due to human activities; 84 percent believe it is a serious challenge for their countries; and respondents were evenly split on whether their governments were acting appropriately to address climate change issues (Tolba and Saab 2009). The sample participants came mostly from the better-educated population, but it shows that there is a firm base and desire for action on climate change across the Arab region.

### **Effects of climate change are socially differentiated and likely to reduce human well-being**

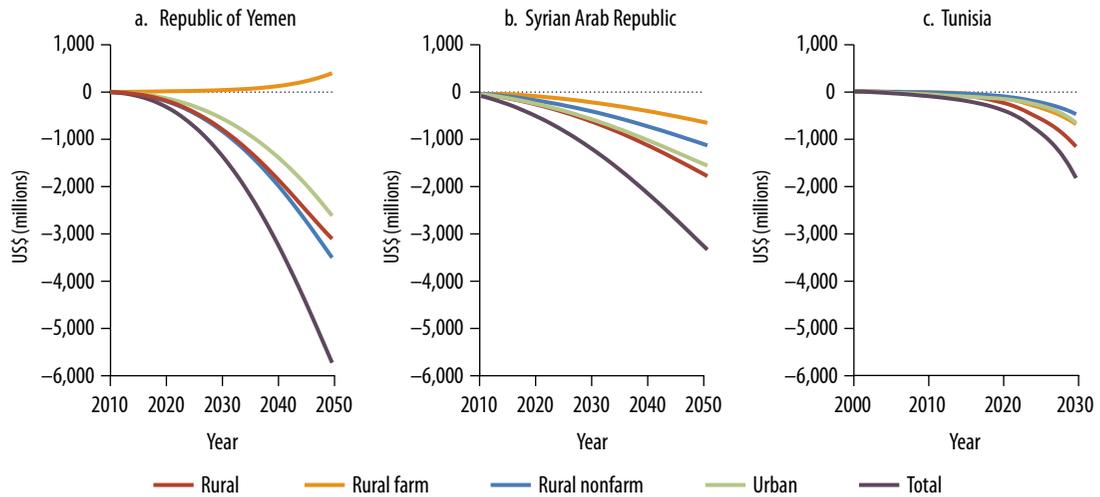
Climate change affects all people in the Arab region. Still, the effects of climate change are regionally and socially unequal, both within and among countries. While wealthier people can enjoy air-conditioned houses and workspaces, asset-poor communities, such as the Bedouin and Tuareg from the arid areas of the Arabian Peninsula and North Africa, have few resources and little capacity to adapt their current livelihoods to the changing climate.

While experts agree on climatic trends, it is less clear what the socio-economic impacts of climate change will be. Nevertheless, it is likely that the economies of Arab countries will be increasingly affected by climate change over time. This is illustrated by background case studies prepared for this report on income, livelihoods, well-being, and poverty in Syria, Tunisia, and the Republic of Yemen. These studies use a range of models to link many relevant factors such as changes in agricultural production and, given the high dependence of Arab countries on imported food, the global dimensions of food production to suggest how they affect other sectors of the economy. The authors' calculations are based on a modeling suite that includes downscaling of global climate models, crop modeling, global economic modeling, and subnational-level economic modeling. The models take into account that people can freely adapt to a changing climate and in many cases have already done so. These adaptation measures range from switching crop patterns to leaving agriculture or herding in favor of sectors that have greater development potential. Yet results show that over the next 30 to 40 years, climate change is likely to lead to a cumulative reduction in household incomes of about 7 percent of GDP in Syria and Tunisia, and of 24 percent in the Republic of Yemen (figure TS.1).

Rural areas will be hit hardest by climate change because incomes from rainfed agriculture and pastured livestock will suffer losses from more frequent droughts. In Syria, for example, a drought is estimated to reduce GDP growth by about one percent compared to non-drought years. Nationwide, poverty levels during a drought increase by about 0.3 percent to 1.4 percent—depending on the year and household group—and

**FIGURE TS.1**

**Modeling studies suggest that household income will decline significantly—7 percent to 24 percent—as a result of projected climate change**



Source: Authors' calculations based on a modeling suite, including downscaling of global climate models, crop modeling, global economic modeling, and subnational-level economic modeling.

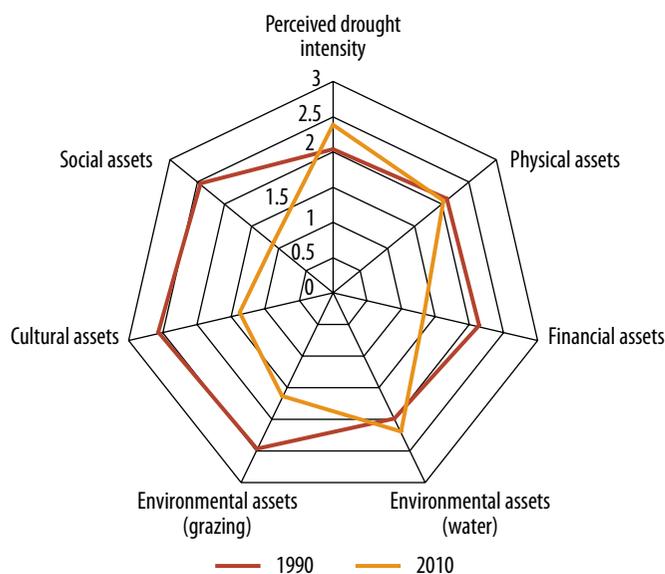
stay above non-drought levels even when the drought is over. Poor farm households are the most affected, followed by rural nonfarm and urban households.

Droughts and floods have long-term impacts on livelihood and well-being. Syria's recent multiyear drought reduced Bedouin livestock herds by 80 percent to 100 percent, which has led individuals and households to adopt new coping measures, such as temporary or permanent migration and agricultural wage labor. Most of the hundreds of thousands of Bedouin migrants have settled informally on the outskirts of urban areas. These adaptation mechanisms mark a departure from the traditional Bedouin way of life.

The Bedouin have also experienced declines in their social and cultural assets and cohesion, which are all important components of their adaptive capacity. In interviews, the Bedouin were asked to compare the recent drought with a similar one in 1990. They said that their access to key livelihood assets was worse now than two decades ago (figure TS.2), with key losses in financial assets, such as loans and cash; environmental assets, such as available grazing areas; social assets, including trust and social networks; and cultural assets, such as effective leadership, capable institutions, and a strong sense of identity. Physical assets, such as infrastructure and transportation and access to water, were not perceived to have worsened in 2010 compared with 1990.

**FIGURE TS.2**

**The Bedouin in the Badia region, Syria, perceive that their key assets to cope with drought have declined between droughts in 1990 and droughts in 2010**



Source: World Bank 2011a.

Note: Interviews with 15 communities in Northeast Syria, December 2010.

Floods are projected to become more frequent because of climate variability, and as a result further economic losses and spikes in food insecurity will ensue. Impact assessments of the 2008 floods in Wadi Hadramout in the Republic of Yemen suggest that because of the direct losses from flooding, farmers' incomes in these areas suffered most during the year of the flood. But more importantly, the area did not rebound quickly: Real income from agriculture was almost halved during the 5 years following the flood. The number of hungry people spiked by about 15 percent as an immediate result, affecting the brain development of young children.

All people of the region, regardless of location or social class, are vulnerable to the impacts of climate variability and change on water, food security, and health. Cities have specific vulnerabilities that are made worse by rapid urban growth, which is partly driven by the migration of the rural poor. Tourism is a major and growing contributor to many economies of the region, but it too will be threatened if climate change is ignored. Women are both a vulnerable group and the main agents for the social change that will be needed to cope with a changing climate. All of these issues and more are addressed in the following sections.

## Chapter summaries

This report centers upon chapters drafted by Arab region specialists, other international specialists, and World Bank staff. Each chapter describes the effects of climate change and options for adaptation in important topics or sectors: climatology, water, food, urban areas, tourism, gender issues, and health. In preparing each chapter, an effort was made to draw upon the regional literature, whether in Arabic, French, or English. The following sections summarize their main conclusions.

### **The Arab region is projected to become hotter and drier as a result of climate change**

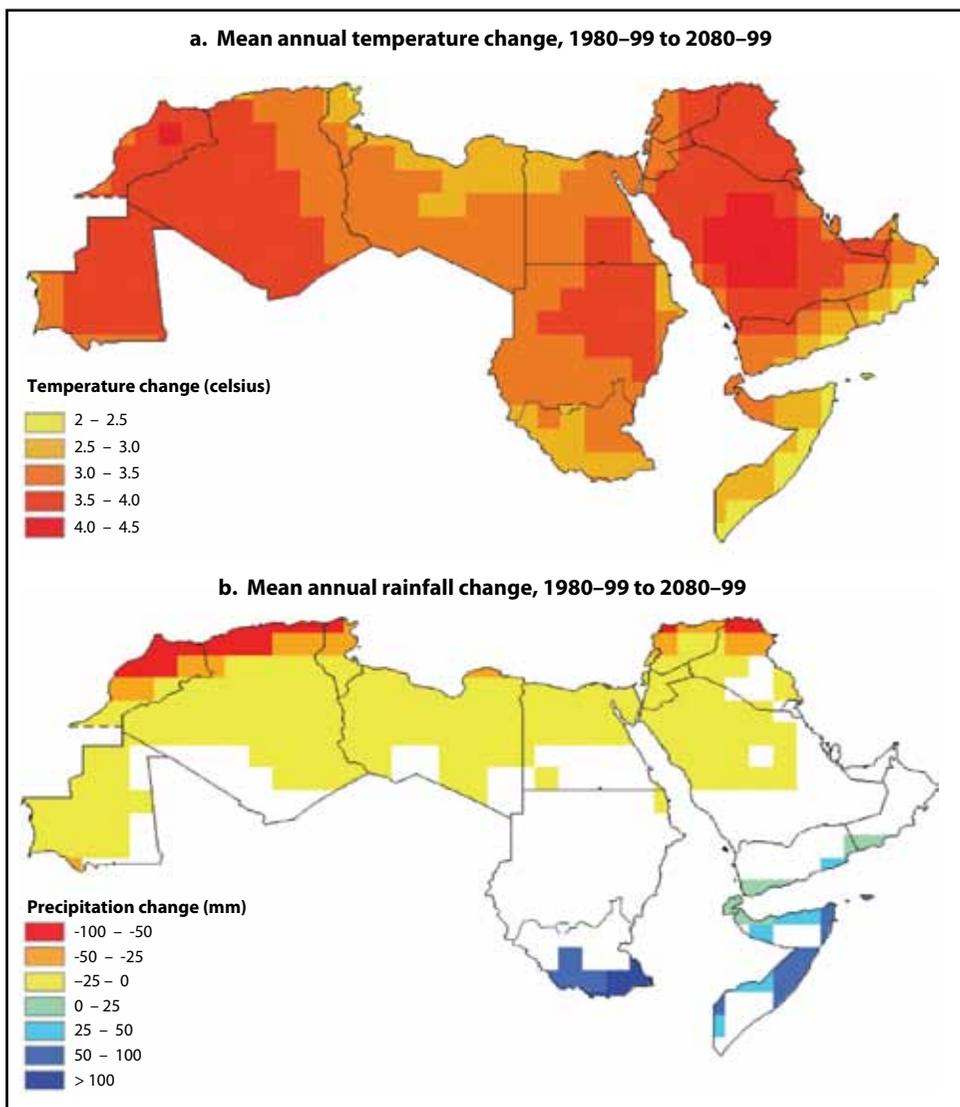
Although the Arab region is mostly arid or semi-arid, it encompasses a diversity of climates. The region straddles the latitudes dominated by descending dry air and high temperatures, which lead to low precipitation, high evaporation, and a persistent aridity. The exceptions include the temperate zones in the northern parts of the region and in the higher elevations of the Maghreb and Mashreq; the tropically influenced southernmost parts of Sudan and the Comoros; and varied coastal climates along the Mediterranean, Red, and Arabian Seas, the Gulf of Arabia, and the Indian Ocean. Climate change is expected to have varied impacts in these different climate zones.

Observational data is essential to determine recent trends in climate and in developing high-resolution projections of future climates. Unfortunately, there are many areas within the Arab region with no weather records, and there are often gaps in the records that are available. In some regions, such as the core deserts, no data has been collected. But in other parts of the region, data exist that have not been made publicly available, either for security reasons or simply because the data have not been quality checked and transferred to electronic databases. An immediate challenge for the region is to improve the quality of its hydro-meteorological data (weather records, stream flow data, etc.) through capturing existing data ('data rescue') and expanding the observational system.

Recent trends in the region show that in most areas, temperatures have been increasing by about 0.2°C to 0.3°C per decade, with extreme heat events far outnumbering extreme cold events. Rainfall trends are more difficult to determine, but there is a possible trend toward reduced rainfall for most of the region. The few stations with long observational records suggest that the frequency of many weather extremes, including hot days, drought periods, and intense rainfall, is increasing.

**MAP TS.1**

**Projected climate change for late this century: Most of the region will be significantly hotter and drier**



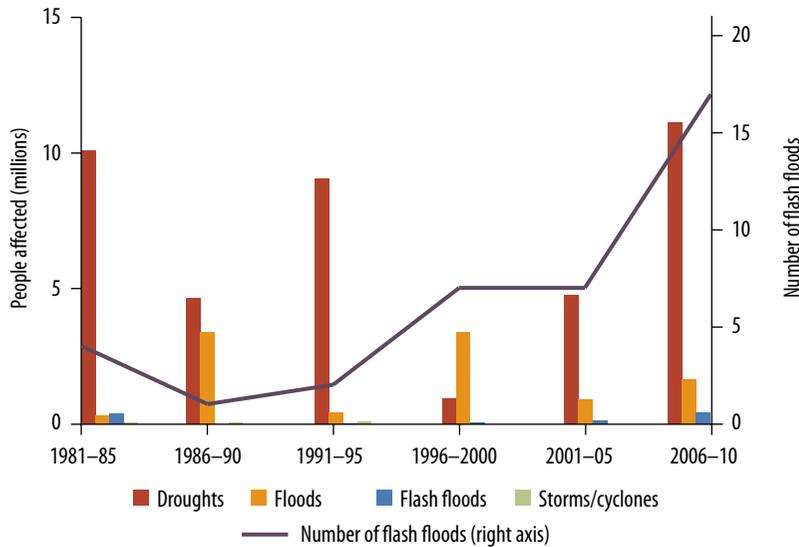
Source: Authors.

Note: Top: mean annual temperature change (2080-99 vs. 1980-99) based on averaging the 24 IPCC AR4 GCMs. Bottom: mean annual precipitation change (2080-2099 vs. 1980-99) based on averaging 23 GCMs. White areas indicate where fewer than 2/3 of the models agree on the sign of the change.

Climate projections in the Fourth Assessment Report of the IPCC suggest that the Arab region will remain predominately arid with many areas becoming even drier and hotter. Temperatures are projected to rise by 3°C to 4°C by the end of the century, which is 1.5 times faster than the global average (map TS.1). Most climate projection models predict reduced rainfall across much of North Africa and the eastern Mediterra-

**FIGURE TS.3**

**There is no detectable trend in the impact of climate-related disasters across the region, but flash floods are rapidly increasing in both frequency and number of people affected**



Source: Authors based on EM-DAT 2010.

nean. Further to the south, in parts of southern Sudan, Djibouti, and the Republic of Yemen, rainfall is projected to increase. There is less agreement among models concerning the desert region between the Mediterranean and the south, but generally this region is projected to remain extremely dry. Throughout the Arab region, the frequency of intense rainfall events is projected to increase, even as annual rainfall levels are set to decline. This trend has already contributed to an increase in flooding and drought events in some Arab countries.

**The hazard risk profile of the Arab region is changing**

Within the Arab region, the interplay of natural hazards, together with the impacts of climate change, water scarcity, and food insecurity, has emerged as a serious challenge for policy and planning for all countries. Over the past 30 years, climate disasters affected at least 50 million people in the Arab region with a reported cost of US\$11.5 billion. Even this number is an underestimate, as the costs of damages are reported for only 17 percent of disasters and rarely capture the suffering that follows the loss of lives and livelihoods.

Droughts and flood victims account for 98 percent of all people affected by climate related disasters (figure TS.3). There is no clear trend

in either disaster frequency or impact as the signal is dominated by occasional very large events. However, the data show a steady increase in the number of flash floods, with over half a million affected in the 2000s compared with only 100,000 in the 1990s. The region's high rate of urbanization, particularly in coastal areas, often multiplies the effects of the floods, storm surges, droughts, and landslides. The increased frequency of flooding and drought events could expose up to 25 million urban dwellers to floods, and these same climate changes could lead to a 30–50 percent drop in water availability, exacerbating existing severe water scarcity. These climate events could lead to increased internal and external migrations.

In response to these threats, the region has launched a 10-year Arab Strategy for Disaster Risk Reduction (ASDRR) with the aim of reducing disaster losses through the identification of strategic priorities; the enhancement of institutional and coordination mechanisms; and monitoring arrangements at the regional, national, and local levels.

### **Climate change reduces the availability of already overexploited water resources**

Challenges in the Arab world include water scarcity (with the lowest freshwater resource endowment in the world), very low and variable precipitation, and excessive exposure to extreme events. All but four countries in the region (the Arab Republic of Egypt, Iraq, Saudi Arabia, and Sudan) are below the 1,000 m<sup>3</sup> of water per person threshold for “chronic water scarcity,” and over half fall below the “absolute water scarcity” threshold of 500 m<sup>3</sup> per person. Furthermore, climate change is estimated to reduce water run-off by 10 percent by 2050. This demanding environment, combined with high poverty rates, makes the region among the world's most vulnerable to climate change.

The region receives inflows of freshwater from adjacent water catchments via such rivers as the Nile, Euphrates, and Tigris. Many areas can draw upon a “fossil” groundwater reserve that derives from much wetter periods in the past. An Arab Water Council report estimates that renewable water resources in the Arab region are around 335 km<sup>3</sup> per year, more than half of which originates outside the region and is delivered by transboundary rivers. The region uses 250 km<sup>3</sup> of the 300 km<sup>3</sup> of freshwater available each year for agriculture (85 percent), municipal uses (7 percent), and industrial uses (8 percent), with only a fraction of a percent remaining for environmental flows.

However, these region-wide numbers hide wide variations country to country. While some countries (Somalia and Sudan) use only a small amount of their available surface water, others (Oman and Saudi Arabia)

rely on groundwater for more than 90 percent of their supplies. In some Gulf States (Kuwait and Qatar), desalination contributes more than 40 percent of their total freshwater.

Recent modeling estimated that the region currently suffers a water deficit of about 43 km<sup>3</sup> per year. Yet with increasing populations and per capita use, demand is projected to rise 60 percent by 2045. Even without climate change the deficit could increase to 222 km<sup>3</sup> by 2045. When climate change is taken into account, even an optimistic (“wet”) scenario leaves a deficit of 104 km<sup>3</sup> in 2045, while a more realistic “dry” scenario projects a 305 km<sup>3</sup> deficit. Climate models also suggest that rainfall variability will increase.

Projections suggest that the major freshwater inflows to the region will be affected differently. The Euphrates-Tigris inflows are predicted to decline due to less precipitation in their catchment areas, whereas the Nile inflows are projected to increase. This is likely to place increasing pressure on transboundary water agreements.

Climate change will also affect rainfed agriculture and pastoralism. Climate models suggest that a zone currently deemed too dry for rainfed agriculture could expand 75 km northward by the end of the century. This would either increase the demand for irrigation water or decrease cropping areas significantly. Also, the dry season, during which livestock struggle with poor pastures and limited drinking water, could increase by 2 months.

The region has developed much of its capacity for large dams and has a high per capita water storage capacity (especially in Egypt and Iraq), but suffers high evaporative losses from the dams. Water evaporation rates are likely to increase under climate change. Still, storage capacity is inadequate in many countries. The Gulf countries, for example, have high desalination capacities but very low water storage capacity. Aquifers are being considered as strategic reserves of desalinated water.

Groundwater management is likely to become increasingly contentious as most aquifers are depleted beyond their natural recharge rates. Most groundwater is a fossil resource with virtually no recharge. In modern times, uncontrolled use by farmers or urban dwellers has maintained livelihoods in an unsustainable way. Attitudes toward groundwater will need to change, as there is a widespread perception that groundwater is abundant and that governments are withholding information on the availability of the resource to stop people from using it.

Arab countries have yet to tap opportunities to reuse treated wastewater. There is also an urgent need to reduce unaccounted-for water (i.e., water leakages or unauthorized tapping) that can surpass 60 percent in poorly maintained distribution networks in some Arab cities. Treated wastewater and improved networks remain large potential water sources.

**TABLE TS.1****Cost of water adaptation measures**

Adaptation measure	Cost (US\$/m <sup>3</sup> water)
Improve agricultural practice	0.02
Expand reservoir capacity (small scale)	0.03
Reuse domestic and industrial water	0.03
Reuse irrigation water	0.04
Expand reservoir capacity (large scale)	0.05
Reduce irrigated areas	0.10
Desalinate using renewable energy	1.30
Desalinate using conventional energy	1.85
Reduce domestic and industrial demand	2.00

Source: World Bank 2012.

Treated wastewater, though, must be managed for its water quality, nutrient loads, etc., if it is to be acceptable and effective. Desalination is a last-resort measure that should be used only after exhausting more cost-effective and sustainable supply- and demand-side options. However, advancements in solar energy can make desalination more competitive in the long-term.

Setting water prices at market value can help stabilize overconsumption. However, creating water service charges is a contentious issue because many Arab countries have complex social welfare systems that hinge on food and agricultural subsidies, which are in turn dependent on subsidized water services and irrigation. Reducing these subsidies—even to recover only the supply costs—may be socially or politically contentious in many countries. To protect the poor, water tariffs can be structured in a progressive tariff system to allow for below-cost rates for the water usage necessary to maintain good health and well-being. Users are willing to pay higher rates for better quality water services. Regardless of how water service charges or other rationing measures are ultimately set, it is important to understand the real cost of water. Opportunity costs are significant under scarce water conditions. For example, the common policy of supplying water for irrigation at minimal or no cost while it is valued considerably higher by domestic users should be reconsidered. Modest policy changes or efficiency gains concerning agriculture's water demand can lead to significant water savings.

Closing the region's water deficit gap is becoming increasingly expensive. A World Bank study considered the costs per cubic meter of water saved or delivered for nine adaptation options. These options (table TS.1) ranged from improving agricultural practices (US\$0.02 per cubic meter of water) to cutting domestic demand (US\$2.00 per cubic meter). The study suggests that closing a deficit gap of 200 km<sup>3</sup> in 2045 would cost at

least US\$104 billion per year for the region as a whole (i.e., US\$0.52 per cubic meter), but with high variability between countries (e.g., US\$0.02 in Algeria and US\$0.98 in the United Arab Emirates).

Climate change threatens to disrupt an already fragile framework for water management across the region. Integrated Water Resource Management (IWRM) seeks to balance water supply development with demand management within a framework of environmental sustainability and participatory approaches, providing a structure for future water-related decision making. But there are no one-size-fits-all adaptation solutions. For example, Gulf countries will need sufficient storage capacity to compliment existing desalination capacity, and will also need to implement wastewater reuse and water-demand management programs. Arab countries dependent on shared water resources, on the other hand, will have to place a high priority on reaching international agreements with border countries to manage water resources.

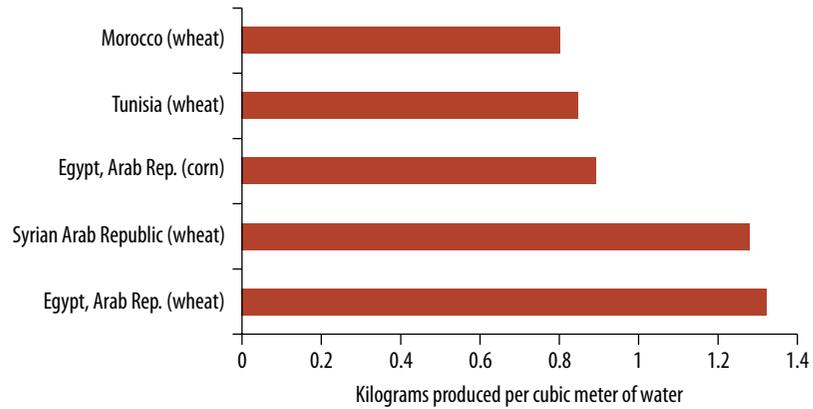
### **Agriculture, rural livelihoods, and food security are challenged in a changing climate**

Agriculture, rural livelihoods, and food security are interdependent issues in Arab countries that should matter to all parts of society. Decreased agricultural productivity can negatively affect food security and prices, particularly in urban areas that cannot grow their own food. Increased food prices can benefit rural producers in the short-run, but if crop or livestock production and rural livelihoods are too badly affected by a changing climate, these populations have been shown to migrate to cities. This leads to urban growth and poverty, among other issues.

Almost 40 percent of regional employment is derived from agriculture. Still, 34 percent of the population in rural areas is poor and unemployment is high, especially for women and youth. Regional agricultural production comes largely from the 10 percent of the land with a Mediterranean climate. Irrigation is the only option for growing crops in some countries. This irrigated land covers only 2 percent of the region's land but provides 17 percent of the production.

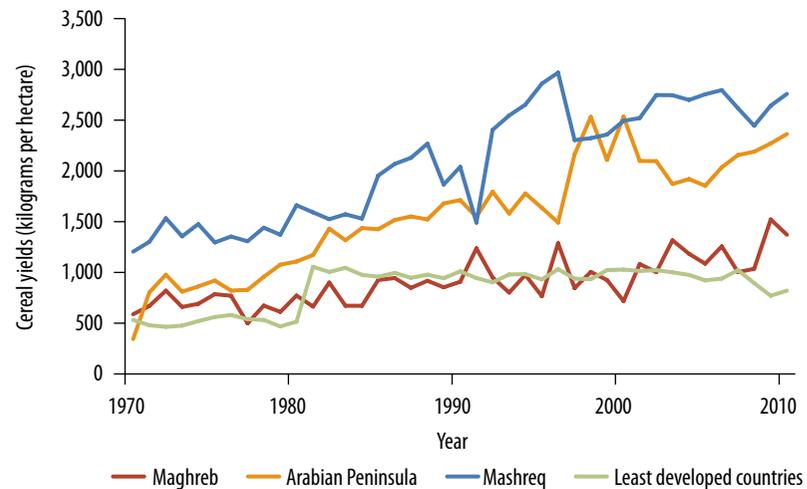
Over recent decades, regional agriculture has become more market oriented with better practices and higher yields. Policies geared toward developing self-sufficient food supplies have favored commercial, irrigated production over investments in rainfed agriculture and pasture. In many areas, this commercial production requires more water than current and future water supplies can sustain. Choices about how to allocate water for agricultural use and what types of crops to produce (e.g., high value, export, or staple crops) are ongoing policy issues for the region (figure TS.4).

FIGURE TS.4

**Productivity of water for irrigated crop fields**

Source: Authors, based on FAO 2002.

FIGURE TS.5

**Cereal yields have increased significantly since 1980 but the rate of increase has declined over the past decade**

Source: Authors based on AQUASTAT.

After two decades of little or no growth in agricultural productivity (1961–80), the subsequent decades (1981–2000) witnessed a strong growth rate of 2 percent per annum (figure TS.5). The causes are complex and vary by country, but a major factor was the implementation of intensive irrigation systems, particularly in the Gulf countries. This growth is not, however, shared across the region, and in some countries productivity improvements have virtually ceased as access to improved

technologies and support services has dwindled, particularly in the least developed countries. Research has made a substantial contribution to yield improvements, but an increased focus is needed for efficient water use and vulnerable systems.

Climate change will likely reduce agricultural production in Arab countries. Projections suggest that the rate of increase in agricultural production will slow over the next few decades and may start to decline after about 2050. Most of the Mediterranean region, which supports 80 percent of production, is projected to have decreased rainfall amid more erratic, hotter conditions. These will increase water use and will likely limit the productivity of some crops. Other areas, such as the Nile Delta, will have to contend with saline intrusion from the sea. Farmers will face additional problems from the higher temperatures: The chilling requirements for some fruits may not be met; new pests will emerge; and soil fertility is likely to decline.

Now facing a drier, more erratic climate, farmers have a number of options to improve agricultural practices, which will not only make them more resilient to climate change, but also increase production efficiency and stability under the current conditions. Switching from wheat to faster maturing crops such as maize, or to more drought resilient crops such as barley, will help achieve both goals. Diversifying crop production to include high value crops such as more climate-resilient fruits and vegetables can make farmers more resilient to erratic climates. There is a need to focus on efficient irrigation through more precise delivery in space (e.g., drip irrigation) and time (e.g., as a supplement to rain-fed crops). With rainfalls projected to be more intense, the value of local water harvesting and erosion control will increase.

Farmers will need better technical and institutional support to meet these challenges. Important among these support systems will be measures to manage risk through weather alerts, simple access to credit and insurance, and social safety nets. Such measures will encourage farmers to move to new farming systems that will be sustainable in future climatic and economic conditions.

The Arab region is home to the genetic ancestors of 80–100 crops, fruit trees, and livestock species commonly used today. Many of these species are of critical importance for livelihoods and well-being in the region and for global food production systems. These ancestral species are a genetic reservoir that might have been lost in domestication, and have the potential to increase water use efficiency and disease resistance if studied further. Their value as a source of adaptive traits is even greater under climate change stress.

Awareness of the effects of climate change and attitudes toward new farming techniques are fundamental to successfully transition to sustainable and resilient production. A survey in the Republic of Yemen found

that 77 percent of farmers knew of the threats from climate change, and over half said that they were ready to change practices. Some farmers see climate change as “a further curse,” others an opportunity to modernize.

Institutionally, the challenge is to manage the bigger picture and to provide the framework for farmer-initiated changes. An immediate challenge is the migration of rural populations, and especially men and youth, to cities in search of employment, supplemental income, and education. Direct rural employment is likely to continue to fall, so managing the transition to fewer but larger landholdings and the social impacts of migration are of immediate concern.

Food security—the access of each household to adequate, affordable, and acceptable food—will remain a continuing policy issue. The region as a whole does well compared with other developing regions, but there are still significant shortfalls in some countries and groups within countries. Climate change will contribute additional uncertainties and volatilities to achieving food security. Local production will be inherently more variable with a changing climate. Both export and import markets will also undergo transitions as all countries adjust to new circumstances. The risk of greater volatility in global food prices must be taken into account in national planning and in establishing the balance between local production, earnings from high-value agricultural exports, and food imports.

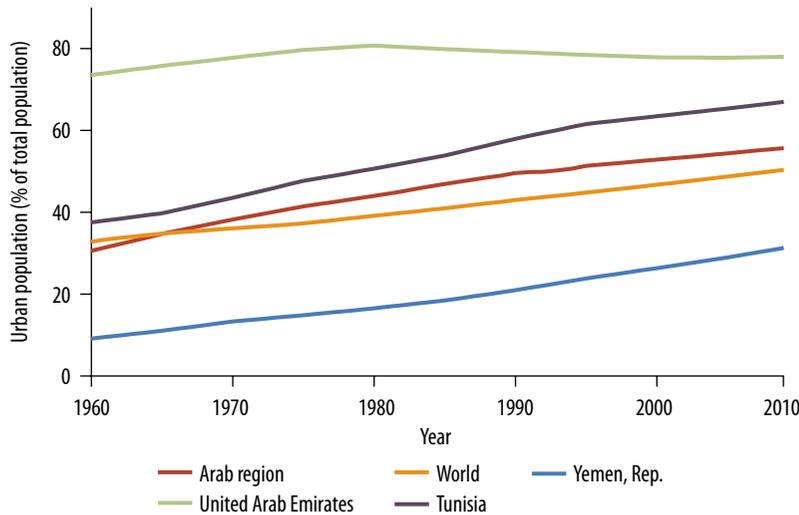
### **Climate change exacerbates the challenges of rapid urbanization and settlement in vulnerable areas**

Although urban livelihoods are relatively less reliant on the natural environment, urban populations are no more insulated from climate change. Climate stress, combined with better social and infrastructural services in cities, has already led to the rapid urbanization of many Arab countries (figure TS.6). As a result, millions of people have left their rural homes to settle in urban centers. The most recent data show that there is a large variation among countries in terms of the urban-rural divide; some countries are almost completely urbanized (98 percent of Kuwaitis live in urban areas) while others are still largely rural (Egypt, Mauritania, Somalia, and the Republic of Yemen, respectively, have more than 50 percent of their populations residing in rural areas). It is necessary that climate change adaptation occur in both rural and urban areas. Although different adaptation options will be deployed in these different environments, it is important in both settings that all parts of society play an integral role in building their own resilience.

Urban populations are rapidly growing: Currently 56 percent of Arab people live in urban centers, and by 2050 these populations will increase

**FIGURE TS.6**

**Urban population growth in selected Arab countries, the Arab region, and the World**



Source: Authors based on World Bank 2011a.

to 75 percent. Many cities are already experiencing severe housing shortages because of this urban population growth.

Historically, cities were established close to waterways to provide sustenance and a means of transport. While initial settlements were located out of harm’s way, later urban expansion led to growth in low-lying coastal areas, deltas, and *wadis*. Historical weather patterns and population distribution made the level of risk in these areas acceptable, but climate change renders these areas vulnerable to flooding and extreme weather events.

Flash flooding is increasing in cities across the region as a result of concrete surfaces that do not absorb water, inadequate and blocked drainage systems, and increased construction in low-lying areas and *wadis*. The number of flash floods and the number of people killed or affected has doubled during the last ten years, with over 0.5 million people being directly affected across the region this decade (see figure TS.3). Climate change will likely increase this hazard further because of more intense rainfall events. In many cases, storm water management is still based on past climatic records with small safety margins to deal with excess water. In cities with joint storm and wastewater drainage systems, floods can lead to public health disasters because of overflowing heavily polluted floodwater.

Supplying water to urban areas is becoming increasingly difficult. Reasons for this include aging pipes, water loss from leakage of 40 percent or

more in some major cities, and the lack of water infrastructure in informal settlements. Poor metering and inappropriate water pricing compound these difficulties. Many urban dwellers are turning to private water vendors or are installing wells, which further deplete groundwater reserves and threaten water supplies for everyone during dry periods.

Droughts have been shown to increase rural-to-urban migration in the region. A recent multiyear drought in Syria is estimated to have led to the migration of approximately one million people to informal settlements around the major cities. The influx of poor and mostly unskilled rural families places greater pressure on urban services.

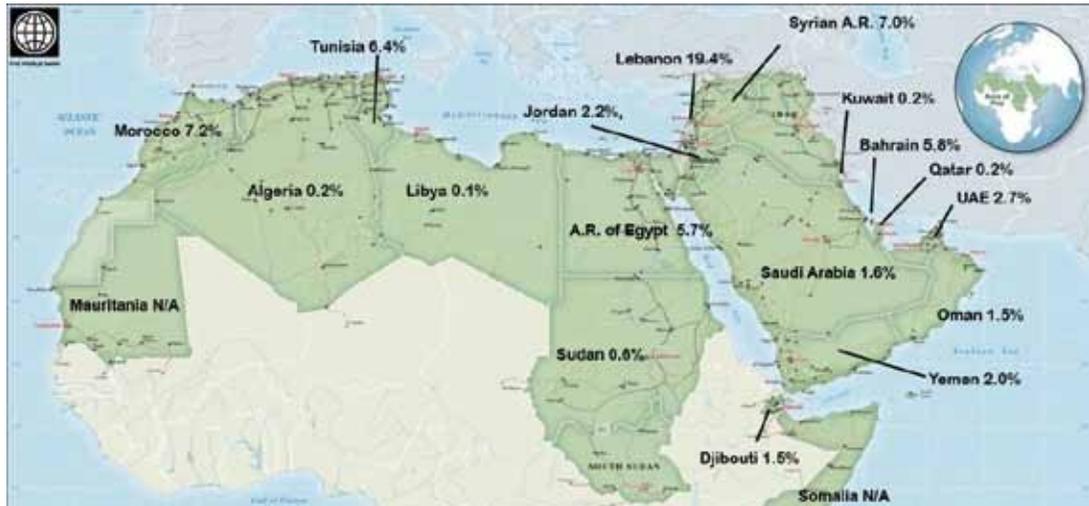
The people of the region are accustomed to coping with extreme heat, but urban areas will face specific challenges. Climate change projections suggest that average temperatures across the region will increase by as much as 3°C by 2050, with night-time temperatures in cities rising an additional 3°C because of the urban heat island effect. The Arab region is already more affected by increasing temperatures than the rest of the world due to the high solar radiation and soils that tend to absorb and store heat. This, combined with the aforementioned heat island effect and poor air quality of cities, will lead to more extreme temperatures; this will be a problem for the bulk of the population in Arab cities who still rely on passive cooling to bring down the temperatures in buildings.

There are two lines of action to help make Arab cities more resilient to the effects of climate change. The first is to continue to improve basic urban planning and service delivery. Many Arab cities are not adjusting to the current conditions and have an “adaptation deficit.” Core steps include building capacities, reducing corruption, enforcing existing regulations and zoning, and creating a decentralized decision making process that is more inclusive. There has been progress in introducing standardized building codes since 1990, including establishing national green building codes such as the United Arab Emirates’ ESTIMADA Pearl Ratings, which focus on environmentally sustainable communities.

The second line of action responds specifically to climate risks. Measures include vulnerability assessments to identify critical infrastructure and its exposure to climate hazards; identifying adaptation options; and determining adaptation cost curves that will allow more systematic comparisons between benefits and costs of specific adaptation measures. Transport systems need to be rethought, first to ensure that they do not block natural water channels and contribute to flooding, and second to ensure that they act as safe evacuation routes or shelters during floods. Ultimately, the success of adapting to climate change in urban centers will depend on cross-sectoral, collaborative enforcement of policy among public, private, and civil sectors.

**MAP TS.2**

**Direct tourism revenues as share of GDP, 2009**



Source: Authors, based on IMF 2011; UNWTO 2011a; UNWTO 2011b.

**Tourism provides opportunities for economic diversification, despite the direct impacts by climate change**

Tourism today contributes about US\$50 billion per year to the Arab region (approximately 3 percent of total GDP) and is projected to grow by about 3.3 percent per year for the next 20 years. It is also an important sector for jobs, because at least seven Arab countries depend on the sector to provide 15 percent or more of total employment.

Tourist attractions in the Arab region range from cultural heritage sites to nature reserves to beach venues. The benefits of this sector are largely concentrated within eight countries that receive over 90 percent of tourist revenues flowing to the region. Tourism’s contribution to national GDPs varies across the Arab countries, from as high as 19 percent of GDP in Lebanon to only 0.2 percent of GDP in Algeria, Kuwait, and Qatar (map TS.2).

Higher temperatures under climate change are an obvious threat to tourism in a region that is already regarded as hot. Analyses of tourism patterns suggest that in the long-term, destinations on the north Mediterranean coast or within Europe will become more attractive than the Arab region.

Other tourists, such as religious tourists or expatriate visitors, are less likely to be deterred by high temperatures. A more significant revenue loss could come from Arab citizens themselves, who may seek cooler des-

tinations. Ski tourism in Lebanon is at risk because projections reveal that the snowy season could decrease from 100 days to 45 over the next few decades. Beach erosion also constitutes a threat, as several studies have found that beach tourists dislike eroded beaches or beaches with major 'hard' protective structures. Civil unrest has also had demonstrable impacts on tourism and could continue to remain a deterrent—especially if associated with a decline in service delivery (e.g., blackouts) or a lack of security.

Nature-based tourism is particularly important in the region but the coral reefs and wildlife that draws the tourists are threatened in many locations. Many of the coral reefs of the region appear more resilient to climate change than elsewhere in the world, but heavy tourist traffic continues to damage them and increase their vulnerability to damage from climate change.

There is reason to be concerned for ancient monuments across the region. Extreme events such as heavy rains or more chronic pressures such as increased salinity in groundwater can threaten the structural integrity of buildings, paintings, and artifacts. Some destinations, such as Alexandria, will be further threatened by seawater inundation as sea levels rise. In most cases, there is already a need to better conserve and protect these cultural sites. Climate change highlights the urgency of the situation.

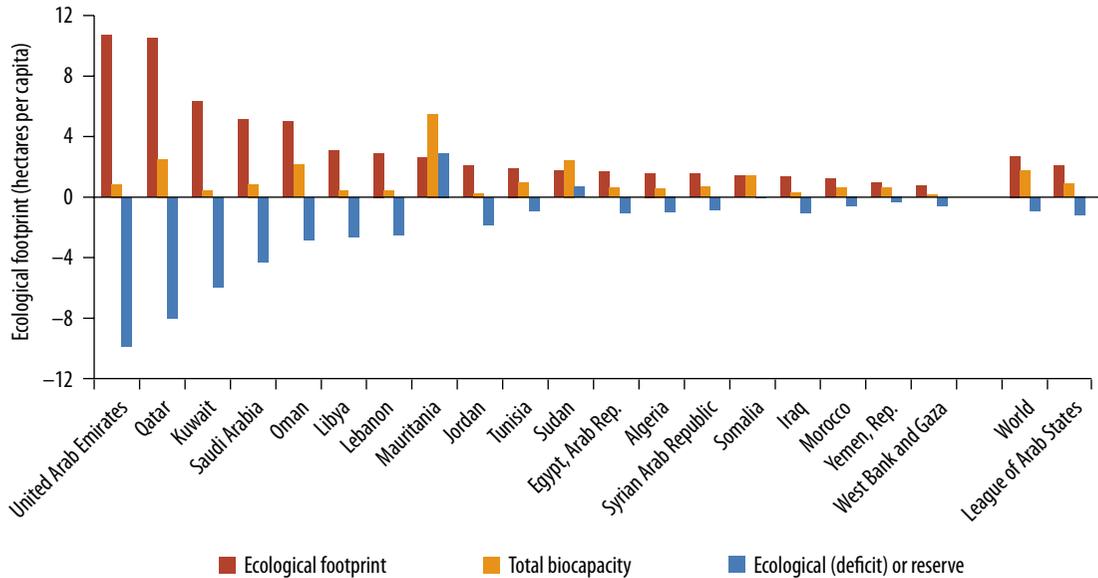
There are a number of responses that the Arab tourism industry can make regarding climate change. In many cases climate change simply adds to the need to improve efficiency in water and energy use or to reconsider the marketing of attractions. These are adjustments that will be beneficial even without the extra impetus of climate change. For example, green tourism based upon energy- and water-efficient infrastructure and activities represents an enormous opportunity. Similarly, some new forms of tourism, such as medical and wellness tourism, are already expanding and are relatively resilient to the impacts of climate change. They also bring with them ancillary benefits within the host country through improved medical and associated services. These and other high-growth, climate-proof tourism opportunities should be pursued.

### **The importance of proper appraisal and management of ecosystems and their services will increase under climate change**

The importance of biodiversity and ecosystem services in livelihoods and economies is often not recognized, and is not considered in national development planning and sector-specific strategies. Better appraisals of ecosystem services, as well as the scaling up or implementation of market and non-market mechanisms can help to recognize biodiversity and ecosystem services as beneficial to Arab livelihoods. Indicators such as the

**FIGURE TS.7**

**The ecological footprint estimates the number of hectares each person in a country requires to maintain their lifestyles**



Source: Authors, based on Global Footprint Initiative 2010.

Ecological Footprint, which measures a given society’s demand on the Earth’s services, are beneficial in this process (figure TS.7). According to the Global Footprint Initiative, the region as a whole is close to the global average of using 0.9 ha excess resources per capita, although there are wide variations among Arab countries.

**Women are stakeholders in adaptation and important agents of change**

Climate change threatens progress in achieving gender equity in the Arab region. Men and women possess unique vulnerabilities to climate change impacts, which are largely based on their respective roles in society. In the majority of cases, women tend to be vulnerable in more ways than men. Still, women should not be seen only as victims of climate change; because of their central role in family, household, and rural activities, they can be primary agents in changing the attitudes and behaviors needed for successful adaptation. A focus on gender is not an add-on to policy formulation but rather an essential part of any development strategy. Effective adaptation can only be achieved if the many barriers to gender equity are removed, and women are empowered to contribute.

There is a great disparity between the situations of men and women across the region as a whole. In some countries, rural poverty, rigid social expectations, and limited education and skills remain a problem, with women having a 15 percent lower literacy rate than men and little voice in decision making. In others, such as the Gulf countries, more women than men graduate from universities and women play an increasing role in decision making. The inclusion of women in national government across the Arab region is only 9 percent, or half of the global average.

Climate change will accelerate the work and time burdens of women and will continue to cause men to migrate to seek alternative productive means. As the viability of rural holdings across the region decreases, a common response is for men to migrate and leave the management of the land in the hands of extended families. This only increases the responsibilities of women. Women have long played a fundamental role in farm activities, especially in physical, time-consuming activities such as stock tending, harvesting, and water collection. All of these responsibilities are in addition to their other familial and household responsibilities. Left alone, they must assume an even greater management role in farming. But here they are often faced with significant barriers. Women tend to have less education; they find travel difficult because of cultural norms, pregnancy, and child care; and they often lack the cultural and legal authority to assert their rights. For example, their access to credit might be limited, access to and control of water is usually ceded to the landowner (rarely a woman), and even access to rural organizations and support systems is often limited.

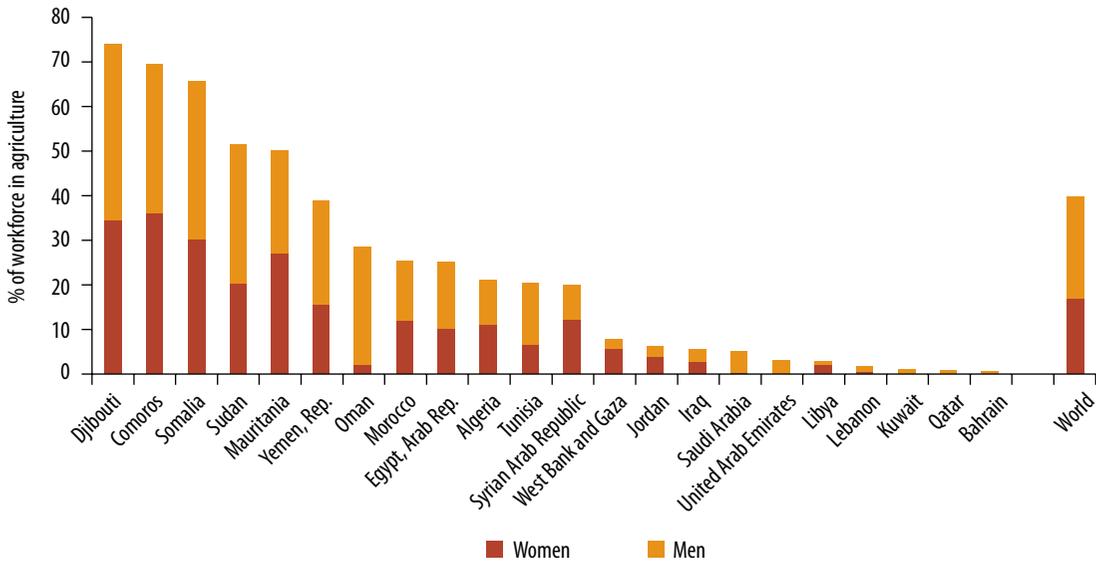
Men and youth drawn to cities for work are also often disempowered. The work undertaken is mostly unskilled and day-to-day in nature, and it provides little security, low wages, and crowded living conditions. The more they commit to remittances, the worse their living conditions in the city tend to become. This can lead to discontent within families and to marital breakdowns.

In 1980, women contributed 28 percent of the agricultural workforce; this has risen to 40 percent in 2010, but with wide variation between countries: there are virtually no women in agriculture in the Gulf States but over 60 percent in Jordan, Libya, and Syria (figure TS.8). The numbers of both men and women employed in agriculture are falling, but at different rates: the percent of men working in the sector declined at a faster rate from 1980 to 2010 than did the comparable percent among women, thus increasing the relative role of women in agriculture.

Several steps can be taken to increase gender equality. These include addressing formal and informal practices that create inequalities in health, education, economic participation, agency, civil rights, autonomy, and participation at all levels. Actions should address both the im-

**FIGURE TS.8**

**The contribution by women to the agricultural workforce (2010) is 40 percent and increasing but with wide variation across the region**



Source: Authors, based on FAO 2011.

mediate and “practical” needs of women and men, such as living conditions, health, nutrition, water, and sanitation, as well as the “strategic” needs of women, which challenge male dominance and privilege by addressing gender-based inequalities. Addressing women’s strategic needs by empowering them and building their adaptive capacities will help tackle the underlying drivers of gender-based vulnerability in the long term. Climate change makes it more urgent to tackle specific drivers of gender-based vulnerability, such as barriers to women’s land ownership, low awareness of climate change, and limited skills for livelihood diversification.

The Global Gender Climate Alliance, in partnership with the International Union for Conservation of Nature and the Council of Arab Ministers Responsible for the Environment, is working to raise awareness of instruments for mainstreaming gender in climate action and encouraging integration of a gender perspective in countries’ United Nations Framework Convention on Climate Change (UNFCCC) negotiations and Conferences of the Parties (COPs). Jordan has been a leader in developing a framework for action (2011–16) that recognizes women as agents of change and seeks to incorporate gender into adaptation policy and planning. The National Jordan Women Commission has incorporated climate change as a core area of concern. This is a welcome step in the re-

gion, as women's organizations rarely have much involvement with agencies engaged in climate issues.

### **Human health is affected by climate variability and change**

The impacts of climate change on human health are varied and often indirect. Higher temperatures are known to lead directly to increased mortality rates through heat stress, but can also indirectly lead to strokes and heart-related deaths. The World Health Organization (WHO) estimates that climate change has already increased the annual mortality rate by 0.2 percent globally. Warmer conditions will also affect the geographic range of disease vectors such as mosquitoes. This will expose new human populations to diseases such as malaria and dengue for which many people are unprepared. Warmer conditions are also conducive to higher rates of illness from water-borne diseases and from more rapid food spoilage, which can lead to gastrointestinal diseases. Changes in weather patterns are likely to expose more people to conditions of poor air quality and increased atmospheric dust. Extreme events such as floods not only kill and injure people during the event, but also leave a legacy of disease, damaged livelihoods, and condemned infrastructure.

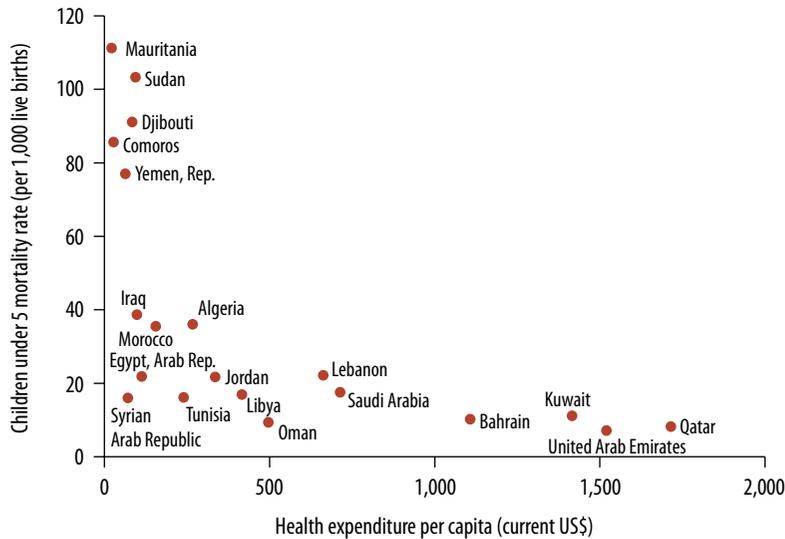
The effects described above are only the most well known and do not include a range of more subtle effects that are just beginning to be understood. For example, higher temperatures and unusual weather conditions can lead to greater pesticide use and greater exposure to toxins, which in turn can cause problems with fetal development and more birth defects. Toxins from algal blooms in warmer waters can contribute to long-term neurological diseases. Only with experience in this changing climate will societies understand the full impact on public health.

Malnutrition and children's health may suffer impacts as well. In the Arab region, climate change and variability is projected to cause serious disruptions to existing agricultural practices. Subsequently, higher food prices can lead to widespread malnutrition, greater exposure to diseases, and other health problems, especially if greater migration to unsanitary, informal settlements is triggered. The impacts on children are particularly troublesome because they lead not only to increased child mortality, but also to developmental and long-term physical and mental impediments.

Poorly implemented adaptation measures can also negatively impact human health. The increased use of wastewater must be carefully regulated to ensure that it does not become a source of disease. For example, the Nile Delta has been the site of increased organic matter and bacterial counts from untreated sewage; it is possible that the poor control of sewage water used for irrigation is an issue in some locations.

**FIGURE TS.9**

**The relationship between health expenditure per capita and child mortality is an indicator of the effectiveness of that expenditure**



Source: Authors, based on World Bank World Development Indicators, 2012.

Certain groups among Arab populations can be identified as the most vulnerable to climate change. These include the elderly, children, and pregnant women—people who are the least able to fend off the health impacts of climate change. Vulnerability is also highly related to particular geographic locations: people in low-lying areas (coastal zones and floodplains) will be more prone to flooding and resulting health impacts; those in rural areas often have fewer resources and poorer health care facilities; and those who migrate to informal settlements are faced with the health consequences of crowding and disease.

In the Arab region some outdoor occupational groups will be particularly affected, namely farmers and construction workers. Increasing temperatures and humidity along coastal areas are creating daytime conditions close to the limits of human physiological tolerance. Already, the work times have been altered in such countries as Qatar to reduce stress on construction workers.

Climate change, coupled with rapid population growth and environmental degradation, will impose an increased burden on health systems that are already stretched to their capacity to respond. Spending per capita varies widely across the region, as do basic health statistics such as child mortality (figure TS.9). Improved public health delivery through

better funding, improved training and technical capacity, and better governance and cooperation is urgent given the health impacts from climate change. The shifting profile of health threats suggests that there should be a greater focus on improving the surveillance of health risks and impacts. This surveillance should go beyond simply monitoring communicable diseases, as is currently in place, to link health impacts to climatic conditions in order to anticipate health threats. To be effective, there should be an emphasis on the use of evidence-based health policy and research, and on greater emergency preparedness to anticipate and cope with extreme events. Strengthening regional cooperation, sharing expertise and research, and engaging climate change specialists on health planning and delivery systems will also enhance adaptation across the region. Currently, regional cooperation is increasing through joint action by Health Ministers and through links with international bodies such as the WHO.

### Implications for national planning

#### **Climate change adaptation should be an integral part of public sector management for sustainable development**

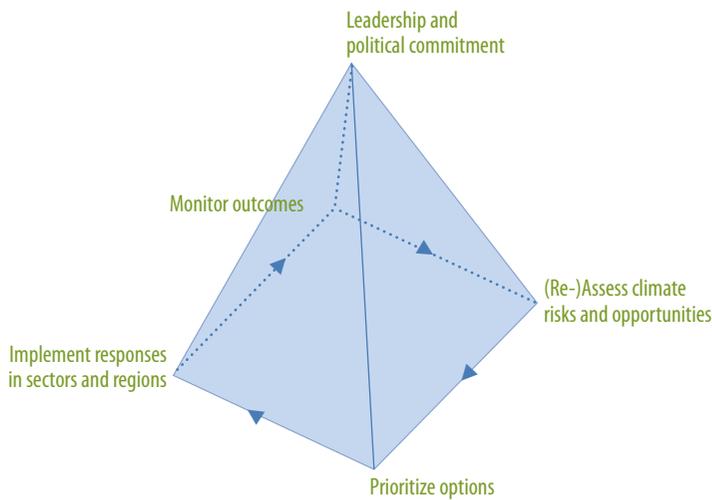
The prospect of climate change adds another element to be integrated into national planning. Governments, with assistance from the private sector and civil society, can ensure that a country's development policies, strategies, and action plans build resilience to a changing climate. Adaptation is a long-term, dynamic, and iterative process that will take place over many decades. Decisions will need to be made as new information becomes available despite uncertainty over how societies and the climate will change. Robust methods for selecting priorities within an adaptive management framework will be required.

The adaptation pyramid (figure TS.10) is one such framework that assists stakeholders in Arab countries to integrate climate risks and opportunities into development activities. It is based on an adaptive management approach, but also highlights the importance of leadership, without which adaptation efforts are unlikely to achieve the necessary commitment to be successful.

The base of the pyramid emphasizes that the adaptive management decision cycle begins with an assessment of climate risks and opportunities and identifies options within the context of other limits and opportunities in development planning. The next step is to identify and prioritize adaptation options within the context of national, regional, and local priorities, giving consideration to longer-term consequences of decisions, as

**FIGURE TS.10**

**The Adaptation Pyramid: A framework for action on climate change adaptation**



Source: Authors.

short-term responses may not be efficient or could lead to maladaptive outcomes. An effective approach for prioritizing options is “robust decision making,” which seeks to identify choices that lead to acceptable outcomes under many scenarios of the future. This approach is particularly well suited to climate change, a problem that will be constantly evolving in the coming decades and will require many options during multiple iterations of decision making. The risk of policy errors is present when dealing with climate change, but a robust decision making process reduces risk.

Adaptive responses will often be somewhat at odds with immediate, local priorities, and thus the third step of implementation requires cooperation and understanding at national, sectoral, and regional/local levels. Successful adaptation must be implemented in a top-down and bottom-up approach that combines national resources with local knowledge of how best to adapt. At the national level, adaptation needs to be integrated into national policies, plans, programs, and financial management systems. The final step is to monitor outcomes to ensure adaptation-related strategies and activities have the intended adaptation outcomes and benefits. Comprehensive qualitative and quantitative indicators can help planners recognize the relative strengths and weaknesses of various initiatives, which feed into an iteration of reassessing climate risks, impacts, and opportunities of adjusting activities to best meet current and future needs.

### **Leadership is central for successful adaptation**

Effective climate change adaptation will not occur without strong leadership and political commitment. International experience shows that the lead needs to be taken at the national level by a prominent ministry or senior government champion, such as the Prime Minister, Minister of Planning or Economy, or State Planning Commission. This champion will also require the support of a strong team of leaders in relevant ministries, governorates, local authorities and institutions, the private sector, academia, civil society organizations, and ideally from opposition parties to ensure continuity as governments change. Leaders from all sectors and from subnational levels will need access to good information, education, and training opportunities and must be treated as legitimate agents in the decision-making processes. Finally, national leaders must interact with other states regarding intergovernmental issues (e.g., riparian states on water flow of the Nile, Euphrates, and Khabur Rivers).

### **A typology of adaptation policy responses**

The Adaptation Pyramid describes the steps for effective decision making, which must be supported by a range of policy measures to ensure that the data and resources (human, technical, and financial) necessary for effective adaptation are available. Some of the most important policy measures for the Arab region are discussed below.

#### **Facilitate the development of publicly accessible and reliable information and analyses related to adaptation**

Access to quality weather and climate data is essential for policy making. Without reliable data on temperature and precipitation levels, it is difficult to assess the current climate and make reliable weather forecasts and climate predictions. Climate stations across the majority of the Arab region are very limited compared to most other parts of the world, and what data exist are often not digitized or publicly available. Localized conflict in the region often disrupts both the collection and sharing of data. However, in many areas, additional data are being gathered by various agencies but are not entered into more widely available meteorological databases.

A civil authority may need to take responsibility for digitizing, sharing, and making the data available to users. This is especially crucial for meteorological services that are under the governance of institutions that may have an alternative agenda (e.g., a Ministry of Defense). In some countries, access to the most current meteorological data may need to be

restricted, but it is important that older data (e.g., one month old or one year old) at daily or sub-daily temporal resolutions should eventually be made public and available on the web.

In the short- and medium-term, the collection and monitoring of climate data could be improved by expanding the number of weather stations, and by collaborating with other countries in the region to improve the coverage and comparability of data. Some of these efforts have already begun. For example, several Arab countries are part of the European Climate Assessment and Dataset, which collates daily observations, performs quality control and analysis, and disseminates the results.

### ***Link climate information with water, food, and socioeconomic data sets***

In many parts of the Arab world, the availability of data that can be used for adaptation planning is poor and will need to be upgraded and coordinated. For example, information on river flows, groundwater levels, and water quality and salinity is critical for assessing current and future water availability. Information on food production and major food supply chains, as well as productivity levels for important crops, forage, and livestock need to be linked with weather and water data to better monitor and understand the effects of a changing climate.

Socioeconomic data, including household, census, and other economic data related to the labor market and production, should be developed or made available. It is important that this information is disaggregated to reflect location, gender, age, and socioeconomic status as these factors greatly affect exposure to, and the ability to cope with, climate risks. Information should be geo-referenced wherever possible so that information on populations, activities, and infrastructure can be interpreted with respect to exposure (e.g., proximity to rivers or the coast, unstable slopes, and flood plains). This is particularly important for rapidly expanding urban areas. Data collection methods should also be designed to be repeated regularly so that trends can be tracked closely over time.

Linking climate and other relevant data will have immediate benefits. For example, most national health surveillance systems collect data related to communicable and noncommunicable diseases, without linking to environmental indicators. By linking these data, as has been done in Oman, West Bank and Gaza, and Kuwait, policy makers can obtain a more comprehensive picture of changing health risks.

### ***Raise awareness***

Collecting and analyzing data is an important step, but equally important is the dissemination of the results to raise the awareness and encourage

people to begin to change their behavior. For example, awareness campaigns about climate-induced water scarcity may reduce household water consumption. Dissemination programs will need to be tailored to the target communities.

### **Provide human, technical, and other resources and services to support adaptation**

Specialized human and technical resources are required to analyze, identify, and implement adaptive responses. General training on climate change and adaptation should be taking place in Arab countries now. This is important not only for raising awareness but also for building the capacity of future populations to take on climate change challenges. This training could be integrated into existing capacity building opportunities or graduate programs in key sectors such as engineering, agriculture, health, or economics. Building Arab expertise in climatology is critical if the region is to benefit fully from the wealth of observational, satellite, and modeling information that is available but not accessed and used effectively by local institutions.

Specific groups of individuals should be targeted for education and training. Mid-career professionals engaged in particular sectors would be one such group. For example, training water utility employees to manage water demand through market-based instruments (like water pricing and metering) would benefit the utility and the society. Rural women who are coping with the effects of out-migration of men could be trained in community and political participation skills, business development, general literacy, and education and extension services. Other groups to target include local government officials, emergency management teams, and poor people engaged in climate-exposed livelihoods. Training can also be targeted to particular geographic areas that are subject to high climate risk. For example, the Amman Green Growth Program provided training on climate change and adaptation options at the urban level in Amman, Jordan.

### ***Research and development***

Research and development is critical for enhancing the understanding of climate change impacts and for developing new and appropriate technological responses. Current research often misses key climate-related factors. For example, health studies between 1990 and 2010 rarely included evidence-based research that directly explored the relationship between climate and health. There is a need to work with existing academic institutions or research institutes to strengthen research and to set up Centers of Excellence in areas relevant to climate change. For exam-

ple, the United Arab Emirates' Masdar Institute and King Abdullah University of Science and Technology in Saudi Arabia undertake research in local meteorology, climate projections, agricultural production, drought resistant crops, and local methods in water reuse, aquifer recharge, and desalination.

### ***Technological resources***

Shifting to new technologies or using existing technologies more effectively is a mechanism to build resilience to climate change impacts. Governments have an important role to play in facilitating the promotion of, and access to, technologies that help people to adapt to climate risks. This is best accomplished through a combination of policy reforms and financial interventions that change incentives to promote private investment in new technology and address key market failures. In the water sector, priority areas include reducing water network leakage, improved storage and conveyance capacity, and reducing water demand through such methods as drip irrigation. In addition, new desalination technologies, which reduce both air emissions and brine discharge, are available and could be supported. New types of food storage or food transport systems could also be endorsed to ensure food security and improve the transportation of agricultural goods to market. Technology transfer is sometimes available but often these technologies can be derived only through local research and development.

### **Build climate resilience through social protection and other measures**

Social protection and other measures that ensure basic human needs are met are critical instruments to building household resilience to climate change for the poor. Resilience is often determined by such factors as an individual's age, gender, and health status, or a household's asset base and degree of integration with the market economy. Underinvestment in social safety nets, public services such as water supply and wastewater treatment, and housing and infrastructure make people more vulnerable to a changing climate. Further, there should be measures in place to ensure equitable access to health care and to a quality education. Such social protection measures include insurance schemes, pensions, access to credit, cash transfer programs, relocation programs, and other forms of social assistance. Such investments and instruments facilitate economic and social inclusion, which creates co-benefits with development goals.

In rural areas with high out-migration rates of men, social protection is particularly critical for the women, the elderly, and the children left behind. Social protection can take the form of rural pension schemes or

conditional cash transfer programs (e.g., Brazil's Bolsa Família). Assistance to enhance productivity can include the facilitated access to credit or markets for agricultural and other rural products. In urban areas, social services can include the provision of affordable housing away from locations at risk of climate impacts or the provision of energy, water, and public transport services. The poor and most vulnerable are particularly in need of assistance when an extreme weather event hits. This includes emergency response provisions of basic needs such as adequate shelter and access to food, water, and clothing.

### **Develop a supportive policy and institutional framework for adaptation**

A supportive policy and institutional framework at national, sectoral, and local levels is essential for effective climate change adaptation decision making. Basic conditions for effective development such as the rule of law, transparency and accountability, participatory decision-making structures, and reliable public service delivery that meets international quality standards are conducive to effective development and adaptation action. In addition, climate change adaptation requires new or revised climate-smart policies and structures at all levels. A clear but coordinated governance structure is also essential to implement climate change adaptation measures.

### ***Develop a national adaptation strategy***

Low-income countries such as Djibouti, Sudan, and the Republic of Yemen have already produced National Adaptation Programmes of Action (NAPAs). These identify priority adaptation activities that respond to urgent and immediate needs. The Cancún Adaptation Framework extended this concept and called upon all developing countries to prepare national adaptation plans (NAPs) as a means of identifying medium- and long-term adaptation needs and developing strategies to address them.

National adaptation strategies provide guidance and a point of reference for policy formulation, planning, and monitoring at all levels of society. If developed through an open and consultative process, they can also be vehicles for raising awareness and building collaboration. A body of knowledge is gradually growing on best practices in developing such strategies.

### ***National governments have a key role to play in promoting collaboration and cooperation***

Within national governments, inter-ministerial coordination is critical, as adaptation responses often require activities involving multiple ministries

and sectors. Inter-ministerial coordination can be achieved through committees that include climate change representatives from each ministry. The private sector, academic, and research institutes can also be integrated into these committees as technical advisors. In 2007, Egypt established the National Climate Change Steering Committee by prime ministerial decree, which includes representatives of each ministry as well as private sector, civil society, and academic advisers.

Coordination between different levels of government is also essential because climate change adaptation policies will ultimately be implemented by sectoral authorities, local officials, and citizens themselves. For example, to educate local farmers on climate risks and adaptation options, it would be wise to use existing farmers' associations that link directly to ministries of agriculture and agricultural research/extension services. This would ensure clear flows of knowledge to all areas from the top down and the bottom up, relying on existing institutional mechanisms. As emphasized in the Adaptation Pyramid (figure TS.10), leadership in promoting active consideration of current and future climate risks and opportunities at all levels is essential.

Regional and international collaboration is also critical for climate resilience. The heterogeneity of the Arab countries and diverse national experiences provide multiple opportunities for beneficial, climate-related regional collaboration. Arab countries will be best equipped to address climate change if they coordinate on issues such as climate-related data sharing; crisis response; the management of disease outbreaks, migration, shared water resources, etc.; and strong trade relationships to address food security. Where knowledge, skills, or technology are lacking in one country, they often exist in other countries. Engaging with international bodies can link Arab nations to new initiatives and knowledge and can improve policy making in Arab states. For example, the World Meteorological Organization (WMO) is promoting a new large-scale initiative on climate services that could benefit from enhanced participation by Arab States.

### **Build capacity to analyze financial needs and opportunities and to generate and manage revenue**

Financial resources independent of development finance will be needed to effectively adapt to climate change. Arab countries will need to invest in building the capacity to analyze their financial needs and generate and manage climate change-related resources.

Current and future climate impacts need to be taken into account when planning and costing investments, particularly over the long term. Financial resources for climate change will come from domestic and international sources, with some international flows specifically addressing

expenses related to adaptation. To access these funds, ministries will need to develop systems to track needs and expenditures in domestic budgets for activities that reduce vulnerability to climate change.

For governments, national public expenditure reviews could be one tool to highlight current expenditures and better understand how these relate to budget estimates for climate proofing activities. This information, in turn, will help governments understand what levels of additional revenues are needed to make up for shortfalls, as well as to identify new revenue opportunities. These revenues could come from the removal of subsidies, the creation of innovative tax mechanisms, or receipts from Payments for Ecosystem Services (PES) programs. PES has significant potential to enhance rural livelihoods and agricultural yields, maintain and enhance ecosystem services such as watersheds and biodiversity, and develop long-term partnerships with the private sector. PES can contribute to disaster risk reduction, with the revenues generated serving as financial buffers for communities vulnerable to climate-induced shocks.

Provided with financing opportunities and incentives, smallholders and rural communities can invest in preventing natural disasters. This can be done by maintaining sand dunes, conserving wetlands, and foresting slopes as cost-effective measures, while at the same time protecting their own assets and livelihoods. Dependable revenue streams would allow them to invest in their crops and land, thus strengthening their businesses.

Funds can be accessed from international sources, which are multiplying. Particularly important for adaptation are the UNFCCC Adaptation Fund, the UNFCCC and GEF-administered Least Developed Country Fund (LDCF) and Special Climate Change Fund (SCCF), the Pilot Program for Climate Resilience (PPCR, under the Climate Investment Fund managed by the Multilateral Development Banks), and the many bilateral funding arrangements. The Organisation for Economic Co-operation and Development (OECD) has estimated that in 2010 about US\$3.5 billion was provided by OECD members to support adaptation activities, with another US\$6 billion for “adaptation-related” activities. For a summary of options available, see [www.climatefinanceoptions.org](http://www.climatefinanceoptions.org).

### **Road map for the report**

The full report seeks to provide, for the first time, a coherent assessment of the implications of climate change to the Arab region. It also serves as a resource to begin to assess climate risks, opportunities, and actions. The information highlighted within the chapters explains the potential impacts of climate change and potential adaptation responses in key sectors such as water, agriculture, tourism, gender and health, as well as in urban

and rural settings. The report attempts to move the discussion one step further by providing adaptation guidance to policy makers in Arab countries. It does this in three ways. First, it proposes the Adaptation Pyramid Framework on how to move forward on this agenda. Second, it puts forward a typology of policy approaches that are relevant to the region to facilitate effective policy responses by decision makers. Third, it provides a policy matrix, which outlines key policy recommendations at the sector level based on each of the chapters.

## A Policy Matrix for Arab Adaptation to Climate Change

	Collect information on climate change adaptation, and make it available	Provide human and technical resources and services to support adaptation
<b>Climatology</b>	<ul style="list-style-type: none"> <li>• Make climate data available at daily or sub-daily temporal resolution</li> <li>• Compile information on availability, conditions for use, and procedures to access data</li> <li>• Rescue and digitize manually archived meteorological data</li> <li>• Extend the coverage of the observational network to ensure a minimal station density to reflect spatial variability (also beneficial to weather forecasting and early warning systems)</li> </ul>	<ul style="list-style-type: none"> <li>• Build capacity to use regional climate data information</li> <li>• Enhance national and regional capacity to make better use of existing international ground and satellite observation data</li> <li>• Promote skills in using and developing climate impacts and risks analyses</li> <li>• Establish regional/international centers of excellence with staff exchange programs to better share skills</li> </ul>
<b>Disaster risk management</b>	<ul style="list-style-type: none"> <li>• Develop consistent approaches to risk assessments at national and local levels</li> <li>• Perform more comprehensive, national multi-risk assessments rather than single hazard, sector and territory specific assessments</li> <li>• Develop more policy-oriented scientific studies and research related to DRM, environments, and ecosystems</li> <li>• Adopt common data standards and methodologies</li> </ul>	<ul style="list-style-type: none"> <li>• Training on climate change, natural hazards, and the adaptation and risk mitigation options at the national and local levels</li> <li>• Develop national strategies on integrating DRM in school curricula and public awareness activities</li> </ul>
<b>Water</b>	<ul style="list-style-type: none"> <li>• Ensure regular, reliable data collection on river flows, groundwater levels, water quality (particularly regarding salinity), climate-related impacts on water, and adaptation options</li> <li>• Develop capacity to monitor and model long-term trends in hydro-meteorological data</li> <li>• Develop regional climate impacts modeling capacity</li> </ul>	<ul style="list-style-type: none"> <li>• Encourage human and technical investments to promote supply- and demand-side management in the water sector</li> <li>• Support climate change and water scarcity awareness-raising programs and campaigns (to achieve both increased water efficiency and to disseminate knowledge of climate risks to water availability)</li> <li>• Support assessment and development of water storage and conveyance capacity</li> <li>• Invest in research and development of appropriate local methods in water reuse</li> <li>• Develop institutes for water quality protection</li> </ul>

Provide assistance, such as social protection, for the poor and most vulnerable	Ensure a supportive policy and institutional framework	Build capacity to generate and manage finance and analyze financial needs and opportunities
<ul style="list-style-type: none"> <li>• Empower civil authority with the responsibility of making meteorological data available for public use at minimal cost (currently services are often under the governance of the Ministry of Defense, etc.)</li> <li>• Link climate data with socio-economic data (including health data) to obtain the information needed to build resilience, particularly as it relates to poor and vulnerable communities</li> </ul>	<ul style="list-style-type: none"> <li>• Enhance regional collaboration on early warning systems, including the use and dissemination of existing extended forecasts (available through WMO, etc.)</li> <li>• Engage with the WMO's new large-scale initiative on climate services. (This initiative depends on the active participation of the member states and it can assist in developing capacities critically needed in the Arab countries)</li> </ul>	<ul style="list-style-type: none"> <li>• Include hydro-meteorological data collection in the government's budget, including costs related to:</li> <li>• Data rescue</li> <li>• Extending the number of weather stations</li> <li>• Establishing centers of excellence</li> <li>• International and regional cooperation</li> <li>• Building capacity and training</li> </ul>
<ul style="list-style-type: none"> <li>• Develop an emergency preparedness response plan to deal with emergent crises; assist the poor and vulnerable to relocate away from high-risk areas; and secure basic needs, such as adequate shelter, access to food, clothing, and drugs for the poor and most vulnerable</li> </ul>	<ul style="list-style-type: none"> <li>• Systematic integration of DRM policies and legislation into public investments at national and local levels, ensuring permanent emergency and response funds</li> </ul>	<ul style="list-style-type: none"> <li>• Capacity to estimate the costs of climate and hazard risk, including the cost and benefit analysis taking climate into account</li> <li>• Capacity to mobilize the needed resources from international financial instruments</li> </ul>
<ul style="list-style-type: none"> <li>• Give priority to assistance for the poor and vulnerable in water-sensitive sectors and regions</li> <li>• Help the poor resettle away from areas at risk of flooding (e.g., <i>wadis</i>) and/or severe drought</li> <li>• Help the poor acquire skills and livelihood options in economic sectors less sensitive to water deficits</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that institutions and policies at national, sectoral, and regional levels consider the impacts of climate change on water resources and infrastructure</li> <li>• Encourage cooperation among different ministries (e.g., agriculture, tourism, trade) on water conservation efforts</li> <li>• Support efforts to place the water scarcity and climate change government portfolios at the highest levels (e.g., the prime minister's office)</li> <li>• Pursue cooperation with other Arab countries on water management and research and development</li> <li>• Make accountability and transparency high priorities in water management and service institutes</li> </ul>	<ul style="list-style-type: none"> <li>• Improve pricing of water as both a means of demand management and a source of revenue, while ensuring affordable access for the poor</li> <li>• Incorporate the costs of climate change-related expenditures regarding water, and integrate water and climate considerations in public financial management</li> <li>• Develop insurance programs for high-risk areas and vulnerable communities to encourage investment in more reliable and accessible assessments of climate change risk (i.e., insuring infrastructure, lives, etc.—especially related to flood risks)</li> </ul>

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### A Policy Matrix for Arab Adaptation to Climate Change (*continued*)

	Collect information on climate change adaptation, and make it available	Provide human and technical resources and services to support adaptation
<b>Rural</b>	<ul style="list-style-type: none"> <li>• Assess changes in agricultural production levels/yields for indicator crops</li> <li>• Model the food supply chains, model how they operate, and how will be impacted by climate change</li> <li>• Monitor state of water (groundwater and salinity levels) and soil conditions (depth and carbon content), and agricultural activities in “most at risk” agricultural zones (using indicator areas of marginal lands, rainfed areas from the four regions)</li> </ul>	<ul style="list-style-type: none"> <li>• Develop knowledge and skills related to climate-resilient agricultural practices, such as growing salt-tolerant, heat-tolerant, and pest-resistant crop and livestock species; conservation agriculture; increasing irrigation efficiency; and using nonconventional water resources</li> <li>• Develop human and technical resources to optimize food chain systems, particularly in transport, marketing, improving value-added developments, and establishing cooperatives</li> </ul>
<b>Urban</b>	<ul style="list-style-type: none"> <li>• Improve linkages between meteorological data and information on urban conditions including:</li> <li>• Exposure (river, coast), population, growth in size, physical expansion (direction and amount)</li> <li>• Risk zones (unstable slopes, low-lying areas, areas of high density)</li> <li>• Spatial information on income levels, economic activities, and built environments</li> <li>• Governance structure</li> <li>• Building codes and enforcement</li> </ul>	<ul style="list-style-type: none"> <li>• Improve training on climate change and adaptation options in urban settings (e.g., Amman Green Growth Program Training on hydro-metrological disasters management—floods, landslides, drought, heat waves, etc.)</li> </ul>

Provide assistance, such as social protection, for the poor and most vulnerable	Ensure a supportive policy and institutional framework	Build capacity to generate and manage finance and analyze financial needs and opportunities
<ul style="list-style-type: none"> <li>• Target food price controls/subsidies during price spikes and crop failures to support the most vulnerable</li> <li>• Support access to markets for agricultural and other rural produce</li> <li>• Support development of schools and training facilities to nurture both basic academic and vocational skills and provide necessary incentives to ensure attendance is possible</li> </ul>	<ul style="list-style-type: none"> <li>• Create a coordinated governance structure to implement climate change adaptation measures at central and local levels across the ministries responsible for agriculture, water, and the economy</li> <li>• Develop a coordinated national policy, likely to be across ministries, supporting food security and rural livelihood developments, balancing risks with possibilities, and mindful of water and energy security vulnerabilities</li> <li>• Create farmers' associations that link directly to Ministries of Agriculture and agricultural research /extension services to ensure clear flow of knowledge to all areas from top-down and bottom-up</li> </ul>	<ul style="list-style-type: none"> <li>• Develop capacity to estimate the financial risks for not applying climate change adaptation and how to maximize risk management through available financial instruments</li> <li>• Enhance capacity to assess all possibilities for meeting food demand while balancing economics with geopolitical risks</li> </ul>
<ul style="list-style-type: none"> <li>• Develop affordable housing away from risk zones (flood zones, drought areas)</li> <li>• Provide basic services for those in affordable housing</li> <li>• Promote urban upgrading of self-built areas</li> <li>• Improve rural areas' service delivery and give people a choice of staying in the rural areas or migrating to the urban areas</li> <li>• Ensure clear and equitable land tenure policy and regularize informal settle when in areas of low climate exposure</li> </ul>	<ul style="list-style-type: none"> <li>• Create a clear governance structure to implement climate change adaptation measures at central and local levels</li> </ul>	<ul style="list-style-type: none"> <li>• Enhance capacity to estimate the costs of taking climate risk into account in planning decisions, including the projected costs of potential damages from taking no action</li> <li>• Enhance capacity to mobilize the needed resources from the international financial instruments</li> </ul>

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## A Policy Matrix for Arab Adaptation to Climate Change (*continued*)

	Collect information on climate change adaptation, and make it available	Provide human and technical resources and services to support adaptation
<b>Tourism</b>	<ul style="list-style-type: none"> <li>• Enhance collection, accessibility and analysis of climate- and tourism-related data including:</li> <li>• Contribution of tourism to economy, employment, and trade balance</li> <li>• Types of tourism and their relative importance and main season, and the number of tourists by category and country</li> <li>• Vulnerability and risk assessment, and monitoring of ecosystems important to tourism: water resources, coastal and marine zones, ecosystems, biodiversity, coral reefs, archeological, and cultural sites</li> <li>• Tourist-oriented weather forecasts (easy access to information and knowledge related to heat exposures and risk reduction)</li> <li>• Monitor the degradation of tourist resources (ecosystems, heritage sites)</li> </ul>	<ul style="list-style-type: none"> <li>• Promote technical improvements to enhance the resilience of sectors on which tourism depends, including water management, protection of natural environments, zoning of land use for minimal exposure, disaster risk management, and evacuation plans</li> <li>• Increase efforts to make new and existing buildings able to withstand stronger weather impact</li> <li>• Coastal erosion control and protection where necessary</li> <li>• Public health management and easy access to information</li> <li>• Increased energy reliability through diversification and shift to renewable ("green") energy</li> <li>• Enhance capacities through education and awareness-raising, particularly among NGOs, governments, business, and local communities</li> <li>• Develop alternatives to traditional tourism</li> </ul>
<b>Ecosystem services</b>	<ul style="list-style-type: none"> <li>• Collect systematic data on the state and changes in biodiversity and ecosystems</li> <li>• Improve data on the distribution and status of ancestors of the crops, fruit trees, and livestock that are endemic to the Arab countries</li> <li>• Improve valuation of services and goods provided by ecosystems and the changes or trends for national accounting and decision making purposes</li> <li>• Enhance data collection on the links between functioning ecosystems and the livelihood needs of poor and marginalized communities in different countries</li> <li>• Information on the need of ecosystem services (e.g., water flows) for societies and environment to help with allocation and trade-off decisions</li> </ul>	<ul style="list-style-type: none"> <li>• Enhance human, financial, and technical capacity to research, understand, and incorporate the roles and values of biodiversity and ecosystems in production systems</li> <li>• Enhance skills and knowledge to conduct economic evaluation of ecosystem services and to incorporate them in development decision making</li> <li>• Bring knowledge and good practices from other parts of the world into the Arab countries, and vice versa.</li> </ul>

Provide assistance, such as social protection, for the poor and most vulnerable	Ensure a supportive policy and institutional framework	Build capacity to generate and manage finance and analyze financial needs and opportunities
<ul style="list-style-type: none"> <li>• Diversification of income by developing alternative tourism (e.g., health-related tourism)</li> <li>• Develop social protection mechanisms and instruments (such as conditional cash transfers, temporary employment programs, micro insurance schemes) to enhance the resilience of the local actors in the tourism sector to face climate change risks</li> </ul>	<ul style="list-style-type: none"> <li>• Develop an adaptation strategy for the tourism sector and integrate it into national, sector-specific, and local strategies and policies</li> <li>• Adapt tourist activities to the changing climate and modify the tourist season accordingly</li> <li>• Promote best practices in development and management of tourist facilities (energy, water, waste, etc.)</li> <li>• Private actors must renovate tourist facilities, create new services, improve marketing, develop new destinations, and contribute to the national efforts to rationalize water and energy use</li> <li>• Public actors must coordinate efforts, issue laws and regulations on: hotel renovation construction, urban and land planning, and sustainability requirements on alternative tourism</li> </ul>	<ul style="list-style-type: none"> <li>• Tap into unique sources of revenue related to tourism and climate resilience such as payment for ecosystem services</li> </ul>
<ul style="list-style-type: none"> <li>• Improve access and rights to biodiversity and ecosystems (especially in times of droughts and fires) particularly for nomadic populations</li> <li>• Improve sustainable management of ecosystems to minimize degradation and thus the assets of the poorest and most vulnerable</li> <li>• Promote alternative livelihoods that are not ecosystem- and biodiversity-dependent (e.g., cultural tourism options, employment in small service/home industries)</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure ecosystem and biodiversity management are part of the national development plans and sectoral strategies, especially for water and water-based pollution management in inland and coastal areas</li> <li>• Assist in internalizing the costs of biodiversity and/or ecosystem service loss/degradation</li> <li>• Establish gene banks and “garden” areas where ancestral crops and livestock can be grown and managed as potential adaptation options</li> </ul>	<ul style="list-style-type: none"> <li>• Develop carbon and climate finance as part of an integrated sustainable land and water management system that helps in maintaining biodiversity and ecosystem services</li> <li>• Develop adaptation funding and payments for environmental services that explicitly incorporate conservation and sustainable use of biodiversity at the genetic, species, and ecosystem levels</li> </ul>

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## A Policy Matrix for Arab Adaptation to Climate Change (*continued*)

	Collect information on climate change adaptation, and make it available	Provide human and technical resources and services to support adaptation
<b>Gender</b>	<ul style="list-style-type: none"> <li>• Ensure that current and future data collection is disaggregated by gender and age and that analyses of these data use this disaggregation</li> <li>• Analyze factors constraining women's access to information and target campaigns accordingly</li> </ul>	<ul style="list-style-type: none"> <li>• Address constraints to women's and children's access to information</li> <li>• Analyze gender patterns in sources of information to improve awareness campaigns, particularly where illiteracy rates are high</li> <li>• Increase rural and urban women's skill-development and capacity-building opportunities</li> <li>• Simplify and disseminate information on land ownership laws</li> <li>• Promote and invest in innovative areas of business in rural economies, particularly those that emphasize/improve opportunities for women</li> </ul>
<b>Health</b>	<ul style="list-style-type: none"> <li>• Establish and strengthen information systems linking health and climate change-related outcomes</li> <li>• Develop climate-sensitive surveillance systems and evaluation techniques for health; i.e., the occurrence and magnitude of climate change-related health outcomes linked to environmental and meteorological indicators</li> <li>• Strengthen health-environment management information systems to enable evidence-based decision making for planning, designing, financing, and implementing adaptation programs to address the climate change-related burden of disease</li> <li>• Collect and analyze information on groups vulnerable to climate change. This includes identifying their specific vulnerabilities and characterizing risk exposures; describing geographical locations and social and economic status; and evaluating access to social protection services</li> </ul>	<ul style="list-style-type: none"> <li>• Strengthen expertise in "climate change and public health" and provide technical support to promote adaptation</li> <li>• Develop and strengthen a comprehensive framework for human resources for health and climate change—both technical and managerial</li> <li>• Encourage academic institutions to invest in climate change and health research and in the provision of technical assistance to Ministries of Health</li> <li>• Build or expand training/graduate programs in climate change and health sciences</li> <li>• Involve civil society organizations in raising public awareness on the health effects of climate change and on ways to adapt at the household and community levels</li> </ul>

Provide assistance, such as social protection, for the poor and most vulnerable	Ensure a supportive policy and institutional framework	Build capacity to generate and manage finance and analyze financial needs and opportunities
<ul style="list-style-type: none"> <li>• Targeted social protection, including insurance schemes, rural pensions, access to credit, and cash transfer programs, taking into account gender-related vulnerability, and in particular, support female-headed households</li> </ul>	<ul style="list-style-type: none"> <li>• Reform property rights laws and practices related to land and property that account for out-migration of men</li> <li>• Create mechanisms to improve the enforcement of land ownership laws</li> <li>• Reduce the significance of marital status for legal status and land/property ownership</li> <li>• Improve existing land access programs, especially by increasing the emphasis on gender in access to land issues</li> <li>• Support women's collective schemes for securing land access rights</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct gender-responsive budgeting to ensure that adequate financial resources are allocated to implement gender mainstreaming and other proposed policies</li> </ul>
<ul style="list-style-type: none"> <li>• Protect the poor and vulnerable through social services</li> <li>• Strengthen health care service delivery by upgrading primary health care, emergency, and ambulatory services to cope with emergent health crises; ensuring equitable access (both physical and financial); and improving the quality of care</li> <li>• Protect populations against catastrophic expenditure and health shocks through social protection for health, especially for the poor and vulnerable, and through improving social spending using proxy means testing</li> <li>• Expand health insurance, social assistance, and safety net programs</li> </ul>	<ul style="list-style-type: none"> <li>• Create an institutional framework for health-related decision making that considers climate change</li> <li>• Develop/update climate change-specific clinical practice guidelines (CPGs) and standard operating procedures (SOPs) covering different levels of health care: primary, secondary, tertiary, and specialized care</li> <li>• Establish a national climate change and health steering committee consisting of focal points that represent concerned ministries and other stakeholders to initiate dialogue on climate change policies</li> <li>• Establish a regional platform for dealing with cross-boundary climate change-related issues within the health sector with the objectives of: (1) containing epidemics and infectious disease outbreaks; (2) facilitating technical /operational cooperation; and (3) supporting public health research</li> </ul>	<ul style="list-style-type: none"> <li>• Securing financial resources to fund potential opportunities to alleviate the burden of climate-sensitive diseases</li> <li>• Health sector-specific public expenditure reviews to account for revenues and expenditures and to inform budgetary decisions and sector-specific budget allocations with a climate change adaptation perspective</li> <li>• Health system analysis focusing on arrangements for governance, organization, and the financing and delivery of health services, including both micro and macroeconomic evaluations of climate change-related health interventions and services. This would inform dialogue on health sector reform</li> </ul>

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