MENA DEVELOPMENT REPORT

# Beyond Scarcity

## Water Security in the Middle East and North Africa

## OVERVIEW

WORLD BANK GROUP

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**This booklet contains the overview, as well as a list of contents, from *Beyond Scarcity: Water Security in the Middle East and North Africa*. doi: 10.1596/978-1-4648-1144-9. A PDF of the final, full-length book, once published, will be available at https://openknowledge.worldbank.org/ and print copies can be ordered at http://Amazon.com. Please use the final version of the book for citation, reproduction, and adaptation purposes.**



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# Contents of the Overview

# Contents of the Book

# Foreword

Water security is a central challenge for the development and stability of the Middle East and North Africa Region—a challenge of interest far beyond the water sector. That is why we hope that the findings from this report will spark discussion not just among a technical audience, but also among a range of regional actors and policy makers, including representatives from governments, the private sector, civil society, and utilities.

Given its relative scarcity, water has always been a source of opportunities and risks in the Middle East and North Africa region. For millennia, investments and innovations in water management have contributed to social and economic development and to extraordinary accomplishments, facilitated by secure water supplies and irrigated agriculture. One might wonder: what makes today's water challenges different from a decade or even a century ago? And how can water security contribute to the region's economic, social, and environmental well-being, and its path to peace and stability?

The answer to these questions lies in the rapid evolution of the Middle East and North Africa's socioeconomic, environmental, and political context. This context is characterized by high rates of population growth, about 2 percent annually, and particularly the expansion of cities, with the region's urban population expected to double by 2050, to nearly 400 million.

Increasing consumption, paired with undervalued water, inadequate governance arrangements, and weak enforcement is leading to the depletion of water resources —especially groundwater—at an unprecedented rate. Unmanaged trade-offs in the water-energy-food nexus are also contributing to an overexploitation of water resources.

Climate change poses another set of pressures on this rapidly evolving context. The negative impacts of climate change on water availability call for urgent action to allocate and use water more wisely. Climate change is also bringing about more frequent and severe extreme climatic events. This will in turn increase drought and flood risks, which will harm the poor disproportionately.

It is an unfortunate fact that many of the most fragile countries are also those with the greatest water stress. Tragically, the Middle East and North Africa region has been in turmoil for several years now. Conflict and increased water stress are revealing the vulnerabilities of existing water management systems, which once delivered services to its citizens and are now failing when they are needed the most.

While the resource challenges will remain daunting, the Middle East and North Africa has an opportunity to expand the use of innovations in institutions and technology. As highlighted in this report, improved water resource assessment and allocation mechanisms have demonstrated more productive use of water in many parts of the world, yet they remain relatively underused in the region. The Middle East and North Africa could overcome scarcity as a constraint on growth and well-being, and increase its ability to withstand shocks and protracted crises, such as climate variability and drought or a refugee influx, while also addressing immediate humanitarian needs such as water and food security.

Given the complex and rapidly evolving social context, this report also shows that water security is about much more than just coping with water scarcity. It entails ensuring the delivery of affordable and high-quality water to citizens in order to reinforce relationships between service providers and customers and contribute to a renewed social contract calling for greater transparency and accountability.

Water security also requires managing the impacts of migration on water supplies to ensure, against a backdrop of historic levels of displacement, that both host and refugee communities enjoy equitable and reliable access without degrading water resources.

Moving forward on this critical agenda requires action at three levels: existing regional networks of public officials such as the programs and councils supported by the League of Arab States and the Food and Agricultural Organization of the United Nations are key to developing the political commitment for needed policy reforms and public and private investments. At the technical level, governments need to work with

the private sector and participate in regional exchanges among water professionals, such as the Arab Countries Water Utility Association, which provide opportunities to learn and share good practices on water solutions. Civil society, especially the region's youth, have a key role in raising awareness of the value of water and the need for actions in support of a sustainable future.

The stakes are high. The region will need to redouble its efforts to manage its age-old water challenges in this era of acute scarcity. The World Bank stands ready to work in partnership with governments, civil society, the private sector, as well as regional and international organizations to enhance the region's water security.

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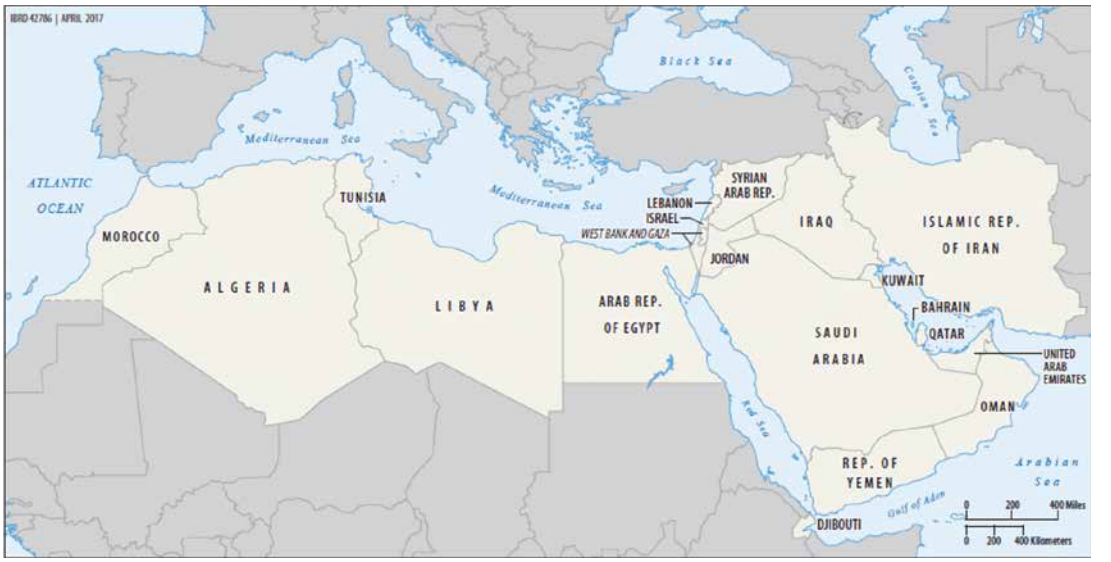
## About the Water Global Practice

Launched in 2014, the Word Bank Group's Water Global Practice brings together financing, knowledge, and implementation in one platform. By combining the Bank's global knowledge with country investments, this model generates more firepower for transformational solutions to help countries grow sustainably. Please visit us at www.worldbank.org/water or follow us on Twitter at @WorldBankWater.

## The Middle East and North Africa Region




*Source:* World Bank.

**The Middle East and North Africa (MENA) region includes the following countries and economies:**

**Algeria, Bahrain, Dijbouti, the Arab Republic of Egypt, the Islamic Republic of Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, the Syrian Arab Republic, Tunisia, the United Arab Emirates, West Bank and Gaza, the Republic of Yemen.**

**The Gulf states and the six members of the Gulf Cooperation Council (the GCC countries) are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.**

**The Maghreb consists of Algeria, Libya, Morocco, and Tunisia.**

**The Mashreq consists of Jordan, Iraq, Lebanon, the Syrian Arab Republic, and West Bank and Gaza.**

# Overview

## The Region's Water Challenges—and the Region's Water Solutions—Extend Far Beyond Water Scarcity

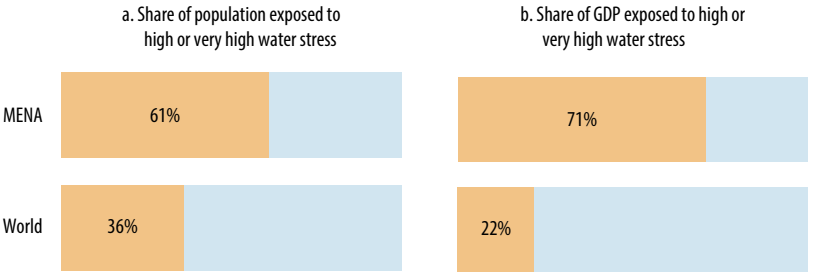
**Of all the challenges the Middle East and North Africa region faces, it is least prepared for water crises**. The World Economic Forum asked experts and leaders in the region: "For which global risks is your region least prepared?" The majority of respondents identified water crises as the greatest threat to the region—greater even than political instability or unemployment (World Economic Forum 2015).

**The Middle East and North Africa is the most water-scarce region in the world.**[1] Over 60 percent of the region's population lives in areas with high or very high surface water stress, compared with a global average of about 35 percent (figure O.1). Over 70 percent of the region's GDP is generated in areas with high to very high surface water stress, compared with a global average of some 22 percent.

**The region's current water challenges go far beyond age-old constraints of water scarcity**. While the region's water scarcity challenges have been apparent for hundreds of years, newer challenges are adding both hazards and complexity. The complexities of the water-food-energy nexus, climate change, droughts and floods, water quality, transboundary water management, and the management of water in the context of fragility, conflict, and violence compound the challenge of water scarcity. Meeting these challenges will depend as much on better governance of water resources as on more and better resource endowments, infrastructure investments, and technologies.

FIGURE O.1

**Share of GDP Produced and Population Living in Areas of High or Very High Water Stress in the Middle East and North Africa Compared with World Averages**




*Source:* Estimates for the Middle East and North Africa from the World Bank. World averages were taken from Veolia Water and IFPRI 2011.

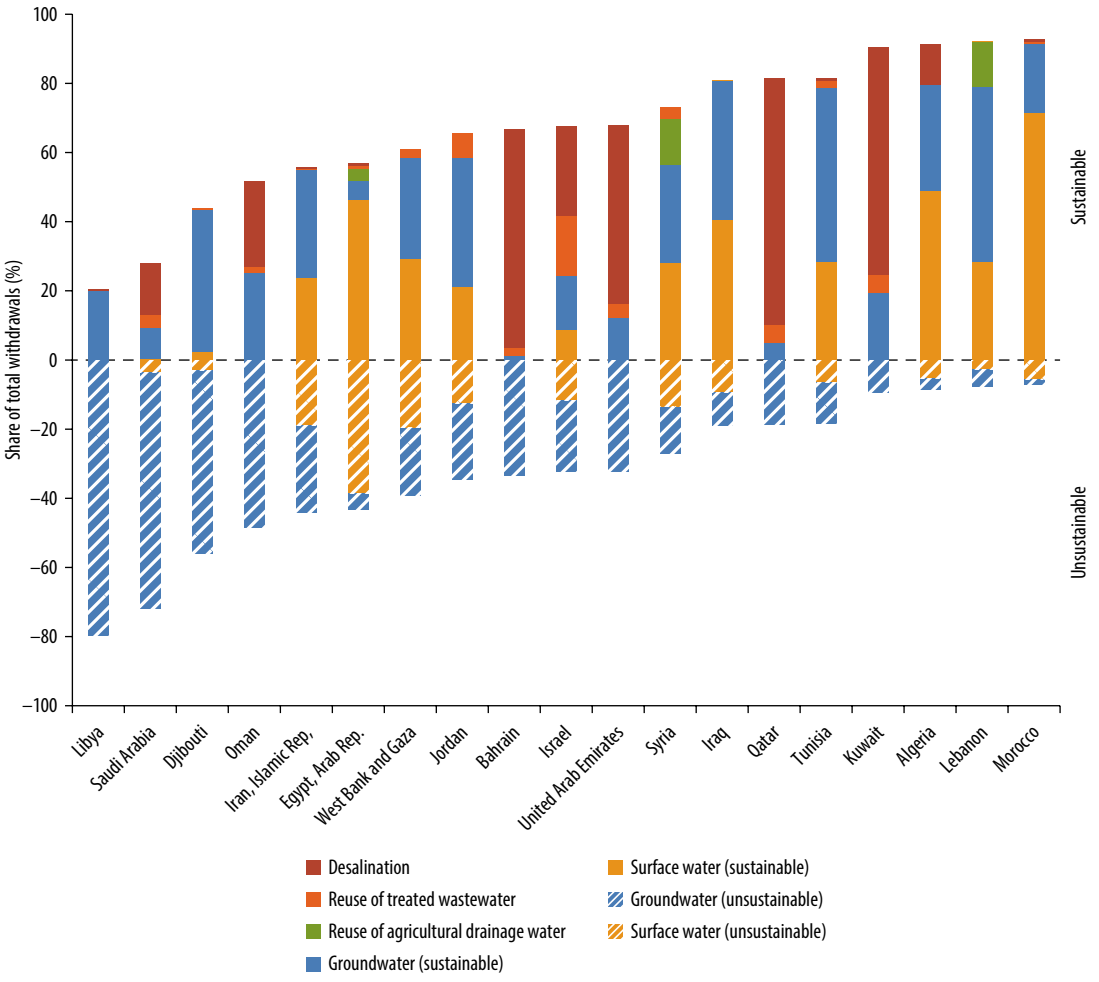
**Many countries in the region are already eroding their water resource base**. For millennia, investments and innovations in water management have been made across the region. However, accelerating economic and population growth coupled with poor governance have now overwhelmed these efforts in many countries. Unsustainable volumes of water are being withdrawn, degrading ecosystems and aquifers (figure O.2). Overdrawing water from rivers and aquifers is equivalent to living beyond one's means—drawing down or depreciating a country's natural capital and undermining its longer-term wealth and resilience.

**A fundamental development challenge for the region is to take the actions necessary to navigate sustainable pathways toward water security**. Sustainable pathways would anticipate and manage the inevitable increases in water scarcity and water-related risks—against a backdrop of climate change, urbanization, growing fiscal constraints, and widespread fragility and conflict. Planning and action are needed to strengthen the resilience of economies and societies to protect them from water-related disasters. Planning and management are also needed to deliver water services that are affordable for both users and government budgets, and to mitigate the costs and social disruptions that can be expected to result from extreme scarcity, sudden supply interruptions, contamination, floods, or droughts.

**Water challenges can compound existing and emerging instabilities and can contribute to unrest and conflict**. Failure to address water challenges in the Middle East and North Africa can have significant negative spillover effects both within and outside the region.

FIGURE O.2

**Sustainability of Water Withdrawals, by Source**




*Sources:* World Bank calculations, based on data on desalination capacity come from Global Water Intelligence 2016a; data on all other categories are from FAO AQUASTAT (database).

*Note:* The percentage of unsustainable groundwater and surface water withdrawals was estimated for this study using the Blue Water Sustainability Index. No data are available for Yemen on sustainability of water use. Caution should be used in comparing data on annual freshwater withdrawals, which are subject to variations in collection and estimation methods. For Iraq, Syria, and West Bank and Gaza, the breakdown between surface and groundwater withdrawals was not available and withdrawals were split equally between the two categories. In absolute terms, Egypt has the largest volume of reuse of agricultural drainage water and Saudi Arabia the largest desalination capacity in the region.

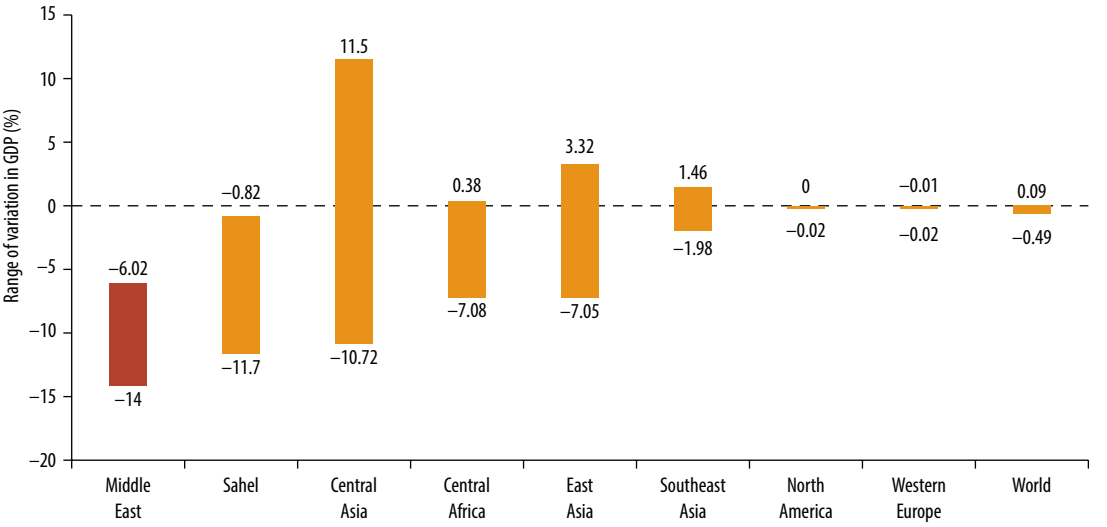
**Water security exists when water is effectively, sustainably and equitably managed both to leverage its productive potential and to mitigate its destructive potential.** Water security has been defined as "the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies" (Grey and Sadoff 2007, 545). Water security goes

beyond water scarcity to take account not only of a country's water resource endowment, but also of the productive and protective actions the country has taken to secure water. Some of the most water-scarce countries in the world are also arguably some of the most water secure—while some of the most water-rich countries in the world struggle to protect their populations from water-related disasters and to provide improved drinking water access.

**Countries that fail to achieve water security forgo potential growth, increase vulnerabilities to hydrological shocks, and may potentially compound social and political fragility**. The MENA region has the greatest expected economic losses from climate-related water scarcity, estimated at 6–14 percent of GDP by 2050, as shown in figure O.3 (World Bank 2016). The impacts of scarcity and hydrological shocks, such as droughts and floods, increase where forecast and warning systems are weak, stormwater and flood management are inadequate, irrigation infrastructure is minimal, and water stored in reservoirs and aquifers is insufficient. Governments' failure to deliver basic water services, and to mitigate the impacts of water-related hazards and risks, can erode legitimacy and compound social and political fragility.

FIGURE O.3

**The Economic Impacts of Climate Change–Induced Water Scarcity, by 2050**




*Source:* World Bank 2016.
*Note:* The range of impacts is determined by the type of policies implemented to cope with water scarcity, from a business as usual policy (–14 percent) to a policy seeking to reallocate water to the most productive uses (–6 percent).

**The risks and opportunities relating to water security in the region have never been greater**. Because water scarcity has been a central feature of the region throughout its history, there is potential for complacency in accepting the limitations that water scarcity implies, or for dependence on incremental or traditional responses to water challenges. Given the rapid growth of the region's economy and population, incremental solutions are increasingly inadequate and unaffordable. Fortunately, at the same time, many countries have demonstrated success in implementing innovative programs to diminish wasteful nonrevenue water (water that is produced and lost before it reaches the customer), to increase water productivity, and to produce nonconventional water through wastewater recycling or desalination. The cost-effectiveness of these technologies is also rapidly improving, changing the landscape of options for the next generation of water management.

**Achieving water security in the Middle East and North Africa requires a new way of looking at water management**. The policies, incentives, and institutional weaknesses in many countries have led to inefficient and low-value water use as well as unreliable water services and unregulated water usage and wastewater discharge. Despite water scarcity, the region's water service fees are very low, and its effective water subsidies are the highest in the world (Kochhar et al. 2015). These policies promote resource degradation, aggravate fiscal deficits, and compound vulnerabilities. The way in which water is delivered, allocated, priced, and managed can have profound implications for the region's economic growth. It will influence the structure of its economies and its environmental sustainability, along with social inclusion and regional stability.

**Now and in the future, a broader range of tools, technologies, and policies will need to be considered, debated, and implemented**. Investments in water infrastructure, information systems, institutions, and technologies will be needed. Societies will need to move beyond the traditional approach to managing scarcity by augmenting supplies, and consider controversial solutions. These may include policies that create incentives for water conservation and water use efficiency, including fees, fines, permitting, and pricing,[2] as well as wastewater recycling and reuse; and the reallocation of water from rural to urban users and from agriculture to industry. Furthermore, social inclusion must be central to the delivery of water services and protection of poor and marginalized populations from water-related risks.

**This report provides a regional assessment of the status of water security in the Middle East and North Africa**. It describes existing

water-related challenges, and it outlines emerging opportunities. It explores three questions that are fundamental to water security:

1. Are the region's water resources being managed sustainably and efficiently?
2. Are water services being delivered reliably and affordably?
3. Are water-related risks being appropriately recognized and mitigated?

This regional assessment provides a foundation to identify the most significant water-related issues and potential entry points for action in the Middle East and North Africa region. It aims to motivate comprehensive assessments of water security at the national level and to stimulate dialogue on water security.

## Question 1. Are the Region's Water Resources Being Managed Sustainably and Efficiently?

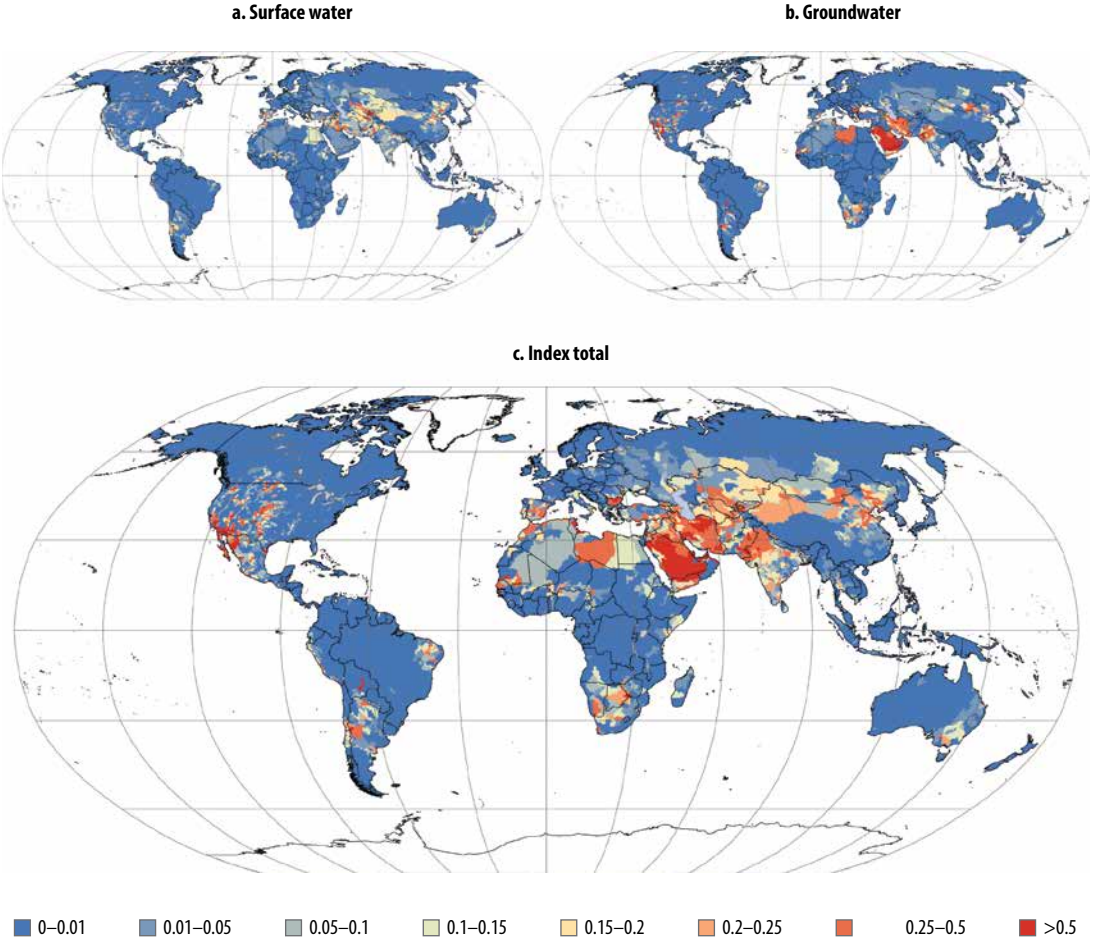
**The Middle East and North Africa is a global hotspot of unsustainable water use.** The region is using far more water than is available on a renewable basis (see map O.1). In some countries, more than half of current water withdrawals exceed sustainable limits. Failure to address excessive water use can lead to the depletion and degradation of both surface and groundwater resources, which compromises livelihoods and development opportunities for future generations.

**The region as a whole faces extreme scarcity, but each country has a different water resource endowment that will shape its broader water challenges**. Some countries rely most heavily on groundwater, as shown in figure O.4. Others rely more heavily on large transboundary rivers. Scarcity is so great in the Gulf states, for example, that there is a strong focus on nonconventional water resources, such as desalination (see figure O.5) and wastewater recycling for nonpotable uses as alternatives to the continued withdrawal of nonrenewable fossil groundwater. Understanding and diversifying the range of potential water resources in the region is essential.

**Groundwater is often used in the absence of alternative sources, or as a buffer against drought, and it may not be apparent beforehand when this crucial resource might fail**. Ongoing groundwater overabstraction may reach the critical point where fossil aquifers are depleted

## MAP O.1

### Global Blue Water Sustainability Index for Surface Water, Groundwater, and Combined Surface and Groundwater, 1960–2010 Average

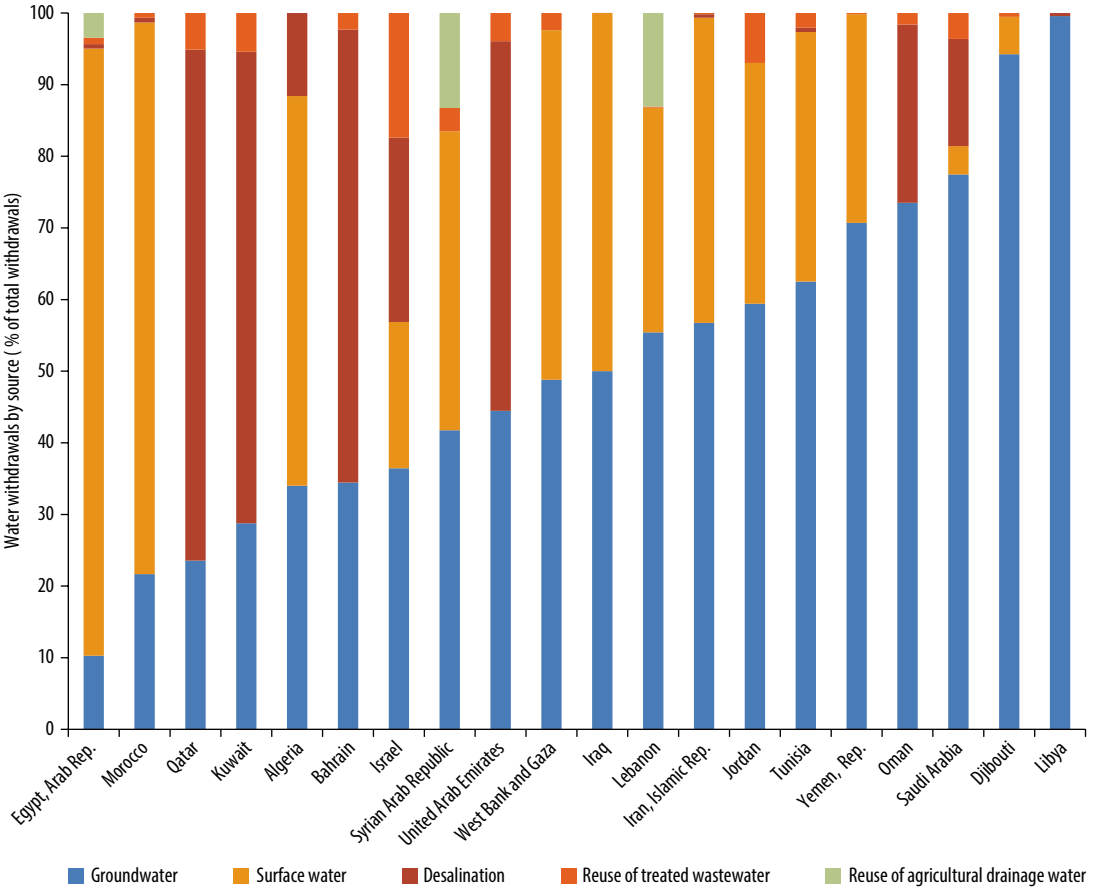



*Source:* Wada and Bierkens 2014.
*Note:* The Blue Water Sustainability Index (BIWSI) measures the portion of water use that is unsustainable. The index is a dimensionless quantity ranging from 0 to 1 that expresses the portion of consumptive water use that is met from nonsustainable water sources. Blue = sustainable; red = unsustainable. Nonsustainable *surface water* use is estimated as the amount of environmental flow requirements not satisfied due to surface water overabstraction. Nonsustainable *groundwater* use is estimated as the difference between groundwater abstraction and natural groundwater recharge plus recharge from irrigation return flows.

and where renewable aquifers are drawn down to the point that abstraction is no longer economically feasible. When aquifers are close to depletion, water quality deteriorates to the point of rendering the water unsuitable for human consumption. It is difficult to predict when aquifers may become compromised, given the large uncertainties in total groundwater storage (Richey et al. 2015).

FIGURE O.4

**Water Withdrawals by Source as a Percentage of Total Withdrawals in the Middle East and North Africa, by Country and Economy, 2010**



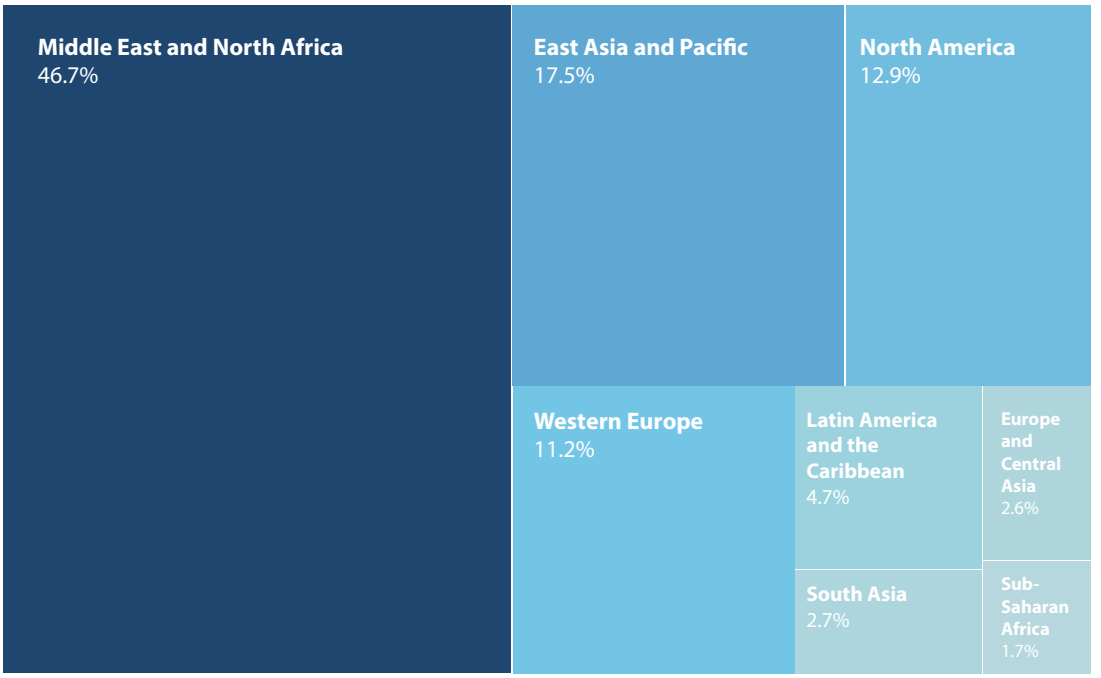

*Sources:* World Bank calculations. Data on desalination capacity come from Global Water Intelligence 2016a. Data on all other categories are from FAO AQUASTAT.

*Note:* For Iraq, the Syrian Arab Republic, and West Bank and Gaza, the breakdown between surface and groundwater withdrawals was not available, and withdrawals were split equally between the two categories. In absolute terms, the Arab Republic of Egypt has the largest volume of reused agricultural drainage water, and Saudi Arabia the largest desalination capacity in the region. Caution should be used in comparing data on annual freshwater withdrawals, which are subject to variations in collection and estimation methods.

**Water quality in the region is degraded by unsustainable water consumption, brine discharge from desalination, pollution, and untreated wastewater**. The cost of poor water quality in the region is estimated to range from 0.5 to 2.5 percent of GDP every year (World Bank 2007). The impacts of this mismanagement range from health damage from the spread of waterborne diseases to the loss of ecosystem services and fisheries that result from the pollution of fresh and marine water bodies. The International Union for Conservation of Nature

FIGURE O.5

**Desalination Capacity, by World Region, 2016**



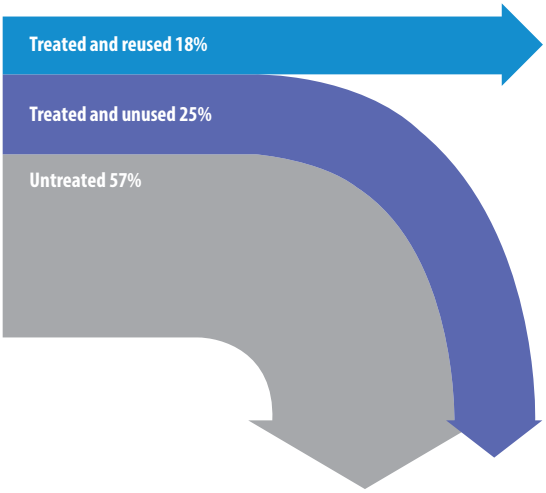

*Source:* Data from Global Water Intelligence 2016a.

estimates that in the Arabian Peninsula alone, 17 percent of freshwater species are threatened with extinction (García et al. 2015). The semi-enclosed nature of the Gulf also means that discharged untreated wastewater accumulates in a "pollutant trap" that threatens marine ecosystems and human activities and livelihoods that rely on marine resources (Van Lavieren et al. 2011).

**More than half of the wastewater collected in the Middle East and North Africa is returned to the environment untreated, resulting in both health hazards and wasted water resources**. There are significant opportunities for recycled water to meet increasing water demands in the region. While over half of the wastewater is not even collected, 57 percent of the wastewater that is collected is returned to the environment untreated (see figure O.6). Egypt, Jordan, and Tunisia treat a significant part of their collected wastewater, but they still have not been able to implement reuse of this water at scale (see figure O.7). This may be a missed opportunity to respond to landscape, industrial, or

FIGURE O.6

**Share of Collected Wastewater That Is Untreated, Treated, and Reused in Irrigation, Middle East and North Africa**




*Source:* World Bank using data from FAO AQUASTAT (database).
*Note:* The figure was generated by summing country-level data on wastewater treated and reused from FAO AQUASTAT. Country-level data are based on estimates provided by the governments and are subject to variations in estimation methods and year of collection.

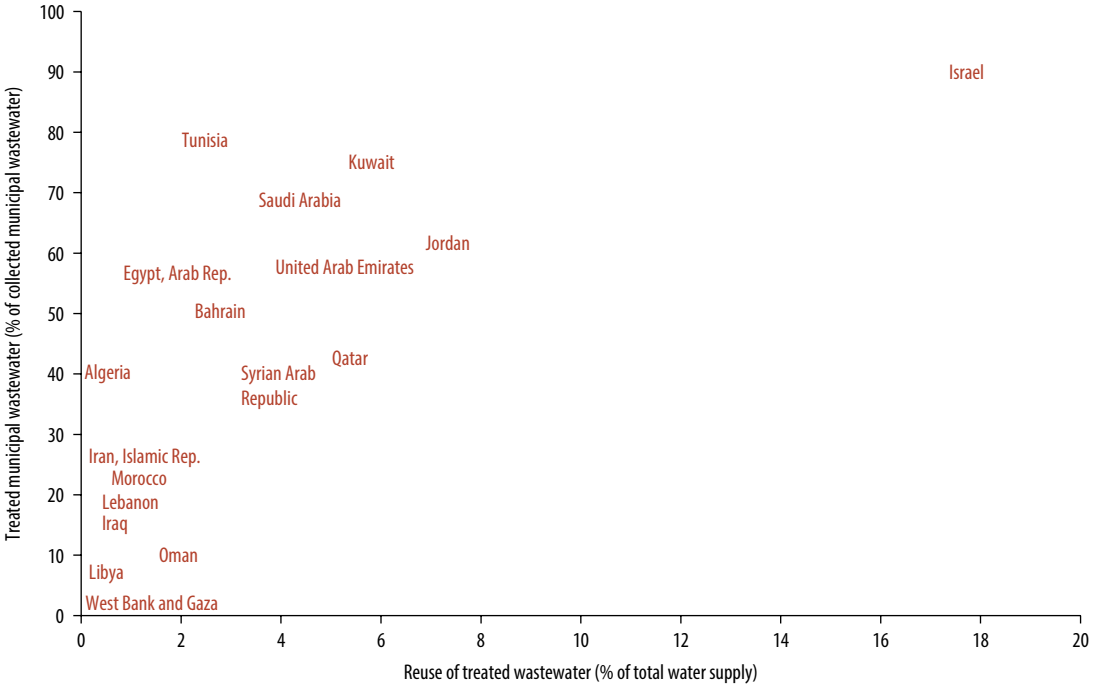
agricultural water demands at a relatively low cost. Recent studies from the region also underscore the economic feasibility of managed aquifer recharge using treated wastewater as part of a wider strategy to diversify supply (Zekri et al. 2014).

**Total water productivity in the Middle East and North Africa is only about half the world's average**. There are striking differences in total water productivity across the region—which features some of the most water productive as well as some of the least water productive countries in the world. Agriculture accounts for nearly 80 percent of the region's water use, somewhat higher than the world average of about 70 percent. Agriculture tends to produce the lowest economic returns from water. Globally, on average, the economic returns of agricultural water are about half that of municipal water, and one-third that of industrial water (Aylward et al. 2010).

**The region has some of the world's highest losses of freshwater resources in its food supply chain on a per capita basis**. Some Middle East and North Africa countries lose between 80 to 177 cubic meters per capita per year of freshwater resources from "field to fork" (Kummu et al. 2012). Agricultural losses, processing losses, and losses

FIGURE O.7

**Share of Wastewater That Is Reused versus Share That Is Treated**




*Source:* World Bank using data from FAO AQUASTAT (database).
*Note:* Data on wastewater produced, treated, and reused in the Middle East and North Africa sourced from FAO AQUASTAT. Country-level data are based on estimates provided by governments and are subject to variations in estimation methods and year of collection. There are no data for Djibouti.

at the distribution and consumption stages are all responsible for this waste. At the consumption stage alone, the UN Food and Agricultural Organization estimates that food waste in the Middle East and North Africa is 32 percent (FAO 2011). In the area of water-intensive fruits and vegetables, this proportion increases to around 60 percent.

**High water subsidies and weak monitoring and enforcement mechanisms undermine incentives for efficient water use**. They encourage overexploitation, and in many countries, perpetuate a pattern of low-value uses and low-water productivity. Part of the water challenge in the Middle East and North Africa lies in managing demands and putting the right incentives in place to save water. These are politically sensitive issues, yet this management is essential to improving water services delivery and water resources productivity. Water service fees can signal resource scarcity and encourage conservation. They can also provide financing for water resources protection, infrastructure maintenance, and service delivery.

**Water governance issues—in particular, the failure to create incentives that signal extreme water scarcity and promote water conservation—are the common denominator of water management in the Middle East and North Africa**. Excessive consumption and resource depletion are the predictable consequences of undervalued water, weak governance arrangements, and inadequate enforcement. Lack of legal frameworks, inadequate enforcement, and poor institutional coordination prevent the region from exploiting recent advances in wastewater treatment and reuse technologies.

**There is important scope for strengthening the sustainability and efficiency of water management in the region**. To better manage the region's water resources and sustainably balance water supply and demand, there are essentially three nonexclusive strategies that can be pursued to strengthen water security:

1. **Use (or lose) less water, to reduce demand**
   Demand management strategies include water service fees and pricing that reflect the resource's scarcity and promote conservation; incentives and technologies to enhance productivity and efficiency control of losses and leakage.

2. **Reallocate water, to realign demand**
   Regulations and market-based tools include planning and prioritization of high value water uses balanced with safeguards for social equity and stability; water rights, subsidies, and pricing policies; regulations and enforcement to control unplanned overexploitation.

3. **Provide (or create) more water, to meet demand**
   Supply side responses include development of a diversified portfolio of conventional and nonconventional water resources; coordinated use of surface and groundwater; stormwater capture, wastewater recycling and reuse.

## Question 2. Are Water Services Being Delivered Reliably and Affordably?

**Water supply and sanitation services account for a very large share of water use in some Middle East and North Africa countries, although they globally represent a relatively small share of water use (around 10 percent)**. In the Gulf states and in West Bank and Gaza, municipal

water demands account for almost half of all abstractions. Projected population growth and migration to urban centers are increasing municipal water demands across the region (Tropp and Jägerskog 2006).

**The Middle East and North Africa region has had one of the best performances globally in terms of increasing access to improved water supply and sanitation since 1990; however, conflict has reversed progress in many countries**. UNICEF and the World Health Organization data suggest that progress on water and sanitation has barely kept up with population growth, especially in urban areas (UNICEF and WHO 2015, 17). Access still needs to be extended to hard-to-reach rural locales and conflict-affected areas. Access gains have been reversed by ongoing armed conflict and migration in the region, causing untold human suffering as well as damaging infrastructure and diminishing institutional capacity.

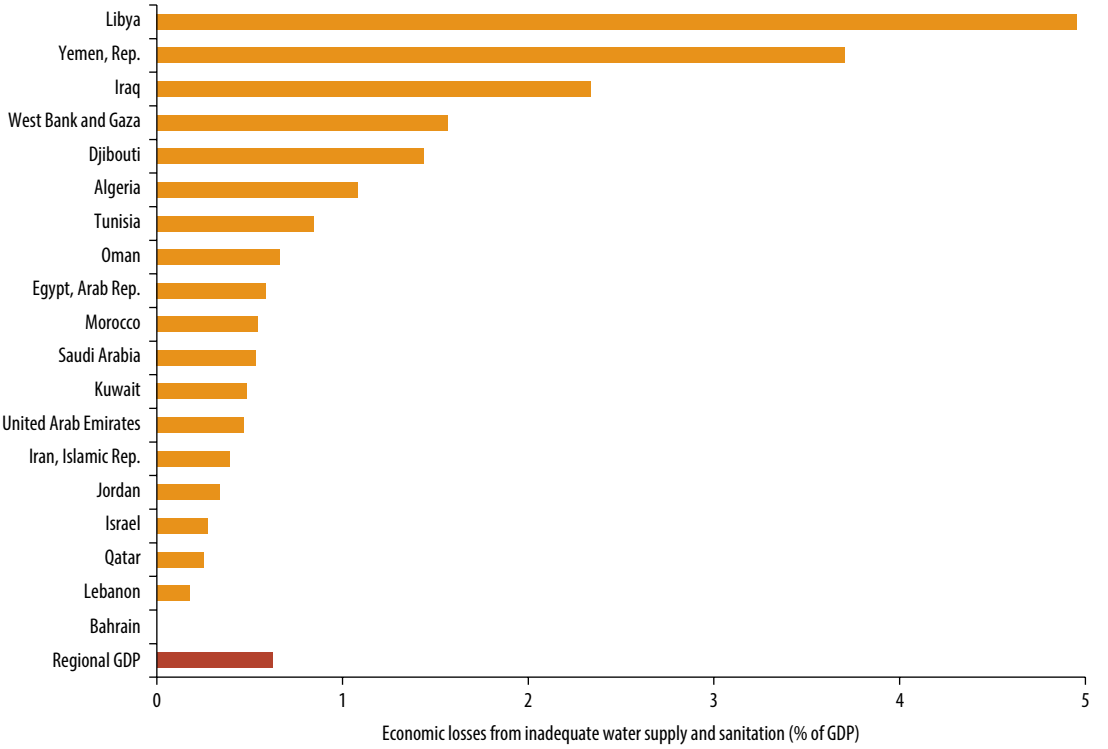
**Access is essential but is only one aspect of water services. The international benchmarks of the Sustainable Development Goals (SDGs) raise the performance bar for the region by addressing the reliability and quality of water services**. The reliability, affordability, and quality of water supply and sanitation services are quite mixed in the region. Statistics mask the reality of intermittent supply. High subsidy rates obscure the affordability of services, both in relation to households' ability to pay and to the government's ability to afford continued subsidization. Improvements in the quality of water services are important to ensure customers' satisfaction and their willingness to pay for water services, and hence the financial sustainability of providing water services.

**Inadequate water supply and sanitation cost the region some $21 billion per year in economic losses**. Mortality due to unsafe water supply and sanitation in a few countries in the Middle East and North Africa, especially those affected by conflict, is greater than global averages. Inadequate water supply and sanitation cost about 1 percent of regional GDP annually, with conflict-affected countries losing as much as 2–4 percent annually (see figure O.8).

**Improving the way in which water is stored and delivered to users of irrigation water could lead to an estimated $10 billion welfare gain annually**. If all the available surface water allocated to agriculture in the Middle East and North Africa could be stored and delivered efficiently to irrigated agriculture, agricultural production would increase 1–8 percent, and the variability in production of some commodities would decrease. Countries that could reap the greatest relative benefits are

FIGURE O.8

**Economic Losses from Inadequate Water Supply and Sanitation, by Country and Economy, Middle East and North Africa, 2010**



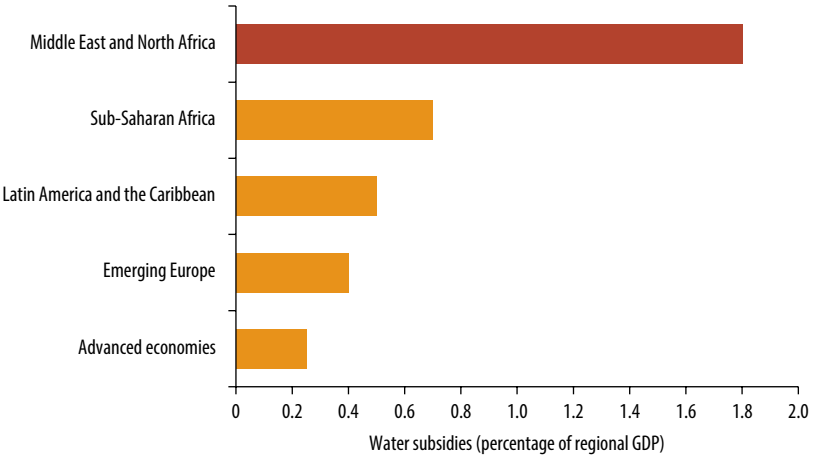

*Source:* Sadoff et al. 2015; Hutton 2013.
*Note:* No data are available for Syria.

Egypt, the Islamic Republic of Iran, and Syria—which is not surprising given that these countries also have the largest proportion of irrigated areas in the region. In absolute terms, the biggest benefits would occur in Egypt and the Islamic Republic of Iran, where irrigated agriculture is a fundamental component of the economy.

**Despite its scarcity, the region has the world's lowest water tariffs and the highest proportion of GDP (2 percent) spent on public water subsidies**. This leads to excessive use of extremely scarce water resources (see figure O.9). Especially in the agricultural sector, water service fees in the Middle East and North Africa do not reflect the scarcity value of water or the cost of delivery (AWC 2014). The region has some of the lowest water service fees for irrigation water in the world, which enables farmers to grow water-intensive crops, and it discourages the adoption of water-saving irrigation technologies (Berglöf and

FIGURE O.9

**Water Subsidies to Urban Water Utilities as a Share of Regional GDP, by World Region**




*Source:* Kochhar et al. 2015.
*Note:* Subsidies are defined as the difference between actual water charges to water users and a reference price that would cover all costs associated with supplying that water.

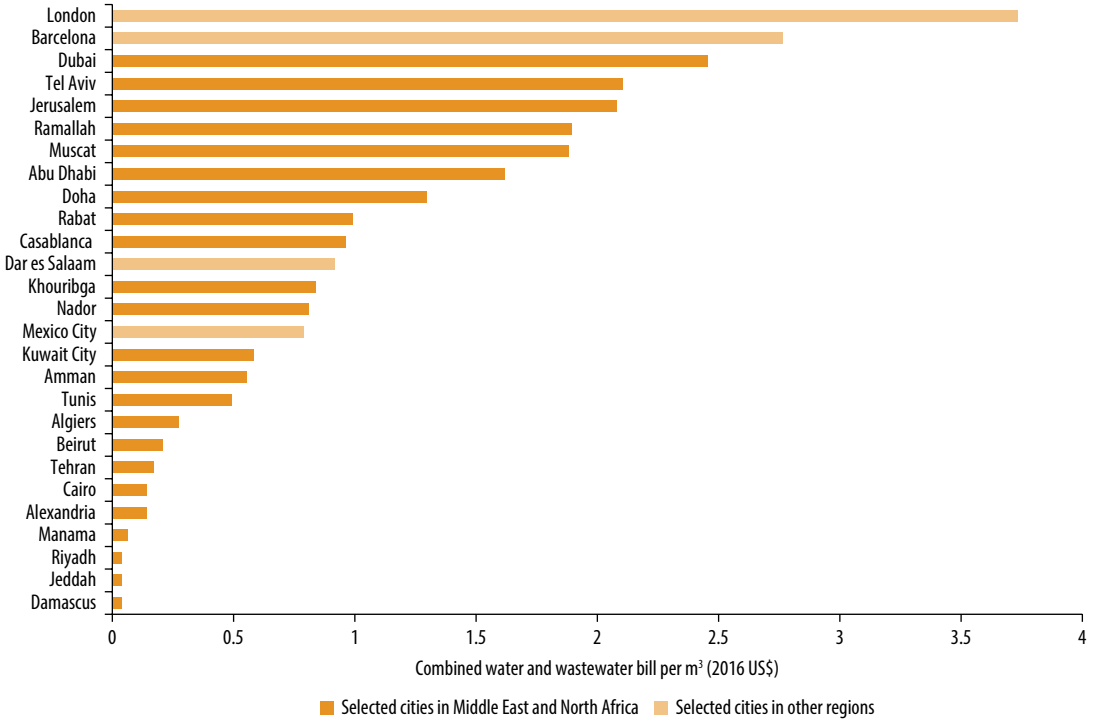
Devarajan 2015). Service fees on drinking water are also very low, with some cities charging seven to eight times lower than elsewhere in the region and in the world (see figure O.10).

**Failure to price water services properly undermines the financial sustainability of those services**. Average service costs exceed average service charges in most Middle East and North Africa countries (ACWUA 2014, table 14), indicating a lack of cost recovery. On average, the price charged for water in the region is about 35 percent of the cost of production for conventional sources (surface and groundwater). In the case of desalinated water, only 10 percent of costs are covered by charges (Gelil 2014). Cost recovery is essential to ensure long-term sustainability of water services. Failure to recover costs can also severely undermine a utility's capacity to treat wastewater, leading to deteriorating water quality and degradation of freshwater ecosystems.

**Subsidies typically benefit wealthier households more than poor households**. Wealthier areas can benefit more from subsidized water than poorer neighborhoods, in some cases (Berglöf and Devarajan 2015). In the worst case, poor households may be located in areas unserved by utilities, requiring residents to buy water of dubious quality from vendors in the informal sector at prices much higher than those

FIGURE O.10

**Combined Water and Wastewater Bill per Cubic Meter, Selected Cities in the Middle East and North Africa and Other Regions, 2016**




*Source:* Global Water Intelligence 2016b.
*Note:* Exchange rates as of July 1, 2016. Average household water use varies by household and by water utility; here it is assumed to be 15 cubic meters per month. $m^3$ = cubic meters.

paid by the rich. Even when the poor have access to piped water, they capture a smaller share of the benefits from the subsidies, because they use less water (Whittington et al. 2015). Available data for selected countries globally suggest that the poorest 20 percent of the population receive less than 10 percent of subsidies incurred by public water utilities, while the richest 20 percent capture over 30 percent of the subsidies (Fuente et al. 2016).

**Service providers' dependence on government subsidies diminishes their customer orientation**. As a result, utilities are more inclined to prioritize service improvements on the basis of political preference—with differing impacts regarding both service quality and inclusion.

**Valuing and pricing water is a politically sensitive issue, but it is essential**. All countries should try to design affordable, equitable, and

sustainable water service fees and subsidy policies. Fiscal pressures could soon force many countries to do so. A recent survey carried out by the Arab Forum for Environment and Development found that 77 percent of respondents were willing to pay more for water consumption in return for improved social benefits (Saab 2015). The valuation of water services should be framed for what it is: a means of recovering the cost of water service provision and a tool to help preserve water resources for future generations by providing an incentive for current generations to consume water sustainably.

**Improving water services could also help strengthen the social compact between governments and citizens**. When governments fail to provide water services, citizens' confidence in institutions is weakened. Reversing this trend requires working toward better service quality, greater accountability of water utilities, and clearer understanding of citizens' expectations with respect to water services.

**Three main innovations can help improve the quality and reliability of urban and agricultural water services: Integrated Urban Water Management, the development of nonconventional water resources, and the use of treated wastewater for agricultural use or managed aquifer recharge**. The private sector has been at the forefront in developing many innovations for augmenting water supplies and enhancing efficiency, but great scope exists to extend private sector participation to improve the quality of water services.

**Improving the quality of water services also requires improving data collection and monitoring**. It is difficult to obtain a comprehensive picture of the quality and reliability of water services in the region, especially for agricultural and industrial users. Monitoring the targets of the new SDGs (in particular SDG 6 on water) provides a tremendous opportunity to build a more evidence-based and comprehensive picture of the status of water services in the Middle East and North Africa.

## Question 3. Are Water-related Risks Being Appropriately Recognized and Mitigated?

**While population and economic growth will increase water demands, climate change will be the primary driver for the most pronounced changes in surface water stress across the region**. Climate change increases water stress through multiple mechanisms, including

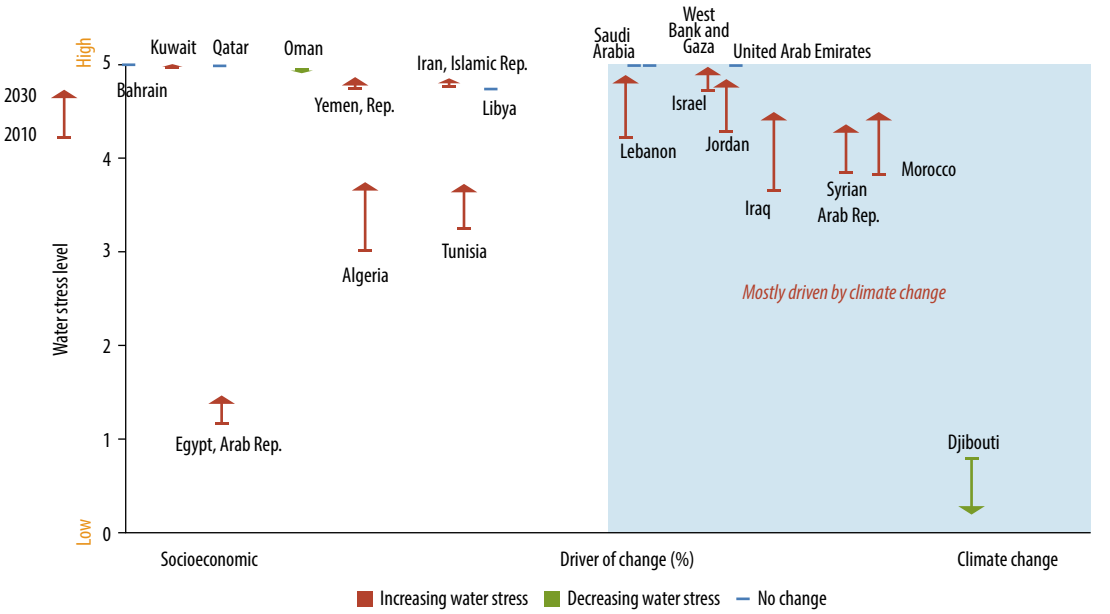
reductions in rainfall and increasing temperatures (IPCC 2014), higher evapotranspiration rates and crop water requirements (Verner 2012), and heat extremes (Lelieveld et al. 2016). Climate change will increase surface water stress in many areas and lead to greater rainfall variability.

**Increased surface water stress due to climate change will occur in countries facing politically and environmentally fragile situations.** Projections suggest that Iraq, Lebanon, Jordan, Morocco, and Syria will all experience significantly increased water stress driven by climate change (see figure O.11). On the other hand, socioeconomic change will drive smaller increases in surface water stress in countries such as Algeria, Tunisia, Yemen, and the Islamic Republic of Iran.

**Climate change contributes to the rise of sea levels, increasing the risk of flooding and salinization of deltas and aquifers in coastal areas of the region.** Low-lying deltas, such as the Nile and the Shatt-al-Arab, have been identified as at risk from the impacts of climate change

FIGURE O.11

**Future Drivers of Surface Water Stress in the Middle East and North Africa**




*Note:* Water stress is quantified as the ratio of annual water withdrawals to average annual surface water availability under an RCP 8.5 (high emission scenario) and SSP2 (business as usual for socioeconomic change). The position of each country along the horizontal dimension reflects the percent change in water stress, which is driven by climate change (right) or socioeconomic change (left). Future climate change is modeled using an ensemble of climate models for a high emission scenario (RCP 8.5). Socioeconomic change is modelled using a middle-of-the-road scenario where future socio-economic trajectories do not shift markedly from historical patterns (that is, a business as usual scenario for population growth and the economy) (O'Neill et al. 2015). Estimates of surface water stress do not account for withdrawals from groundwater and nonconventional water supplies.

(Tessler et al. 2015), as have low-lying coastal areas, such as Morocco's Mediterranean coastal zone (Snoussi, Ouchani, and Niazi 2008). In Alexandria in the Nile Delta, average annual flood losses in 2050 might double, compared with 2005 levels, if the current standard of flood defense is maintained (Hallegatte et al. 2013). Sea-level rise also causes saltwater to intrude into freshwater aquifers and river systems. Coastal areas where groundwater is overexploited are particularly vulnerable to saltwater intrusion into aquifers, because excessive groundwater abstraction makes space for saltwater to flow into freshwater aquifers (Mabrouk et al. 2013). In deltas and river systems like the Shatt-al-Arab in Iraq, the combination of sea level rise and diminished volumes of river outflows allow the tides to push brackish water far upstream in these systems. This can turn river waters and connected groundwater resources brackish, which would have devastating effects on the riverine ecology.

**Flood and drought risks are increasing and are likely to harm the poor disproportionately**. In the Middle East and North Africa, poorer populations are the most vulnerable to weather-related shocks (Hallegatte et al. 2016; Wodon et al. 2014). Floods are the most frequent natural disaster in the region. The percentage of the region's GDP produced in areas exposed to floods tripled from 1979 to 2009. More severe and intense droughts are expected as a consequence of climate change. Recent droughts have been exceptional relative to the natural variability observed in the last millennium (Cook et al. 2016), increasing concerns that drought conditions will be further exacerbated by climate change.

**The interrelationships among the water, food, and energy sectors pose difficult trade-offs and result in unintended consequences**. The need for water to produce food, and the need for energy to produce water (for desalination and groundwater pumping), demonstrate the importance of linkages across these sectors for addressing water security. Integrated approaches across the water-food-energy nexus are required to mitigate water-related risks and achieve the SDG targets. The importance of multisectoral, nexus approaches to solving complex resource management problems has been recognized by the League of Arab States in its Strategic Framework for Sustainable Development (Gelil 2014).

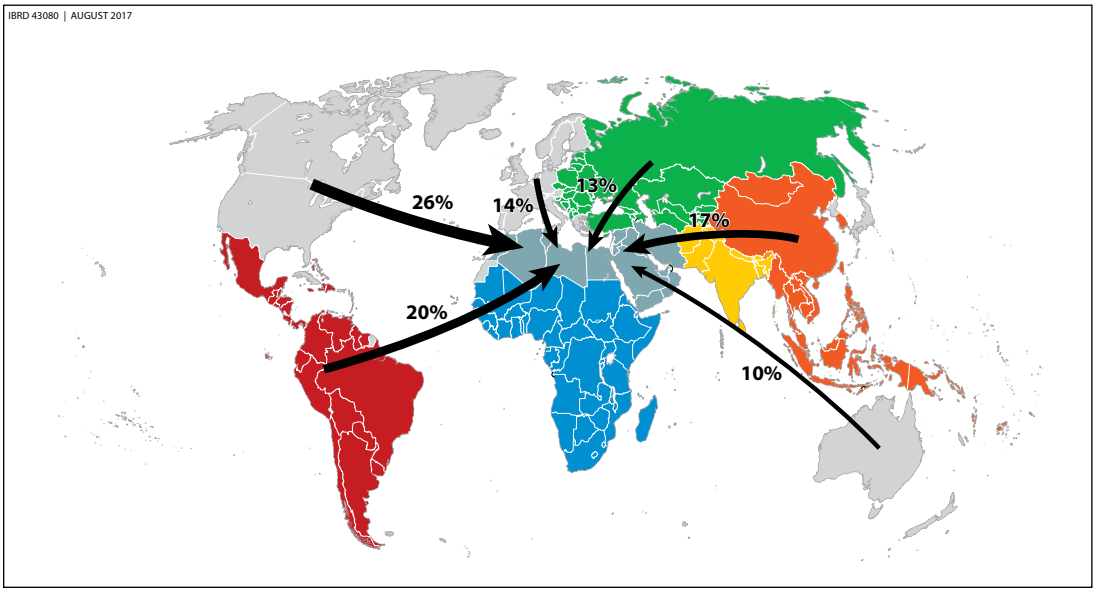
**Trading water embedded in commodities (virtual water trade) provides a way to transfer water resources from other regions to the water-stressed Middle East and North Africa**. The region imports virtual water from around the world (Allan 2001). The United States is the single largest exporter of virtual water to the Middle East and

North Africa, followed by Argentina, Australia, and Brazil (see map O.2) (Antonelli and Tamea 2015). The Middle East and North Africa region is the world's largest importer of wheat, and seven Middle East and North Africa countries are in the top 30 food-importing countries in the world. In the Middle East and North Africa, trade in virtual water can enable a reallocation of water from irrigated agriculture to other higher-value sectors, thereby enhancing the region's overall economic productivity of water.

**Virtual water can help strengthen water and food security simultaneously, if the associated risks are managed**. First, the direction of the net water trade needs to be managed. Virtual water imports to the region increased by more than 150 percent between 1986 and 2010 (Antonelli, Laio, and Tamea 2017). Virtual water exports from the region increased by more than 300 percent over the same period, but they have been declining since 2010, following new polices and export restrictions (Antonelli and Tamea 2015). This points to the importance of aligning a country's agricultural and trade policies with its water security goals. Some states are reluctant to become too dependent on imports, because both food and water are seen as issues of national

MAP O.2

**Net Virtual Water Trade with the Middle East and North Africa by World Region, 2015**




*Source:* World Bank with data from Antonelli and Tamea 2015.
*Note:* Thickness of the arrow denotes the relative amount of water imported to the Middle East and North Africa from that region.

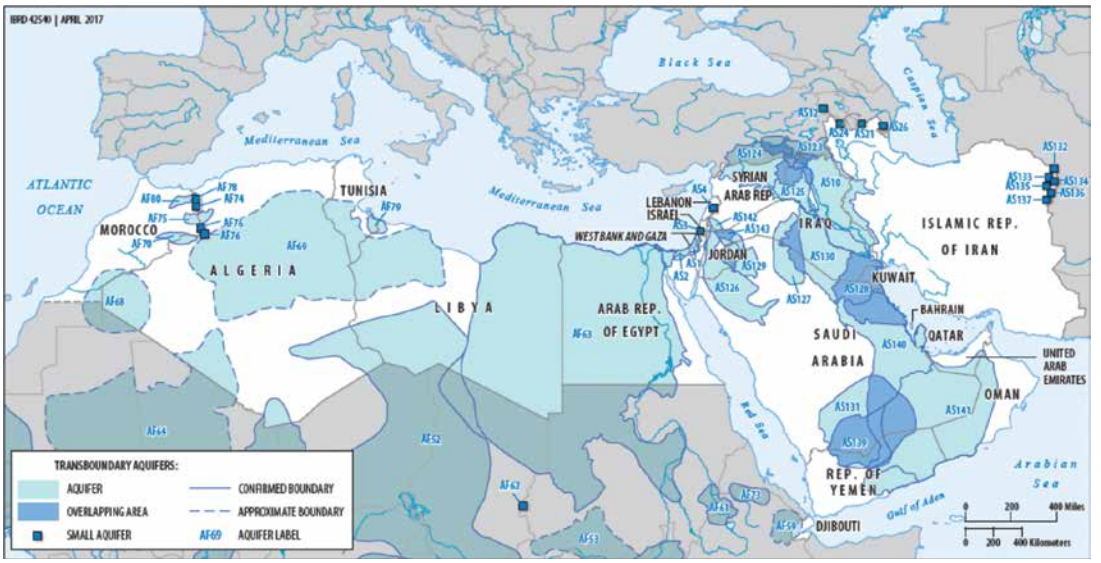
security (Swain and Jägerskog 2016). Food price shocks, transport disruptions, and other systemic risks can affect the trade in virtual water. There are also associated social risks to be managed, because large populations depend on agriculture for their livelihoods.

**Reliance on shared transboundary waters adds a layer of uncertainty and potential risks to water resources management and planning in the region**. A large part of both surface and groundwater resources in the Middle East and North Africa are transboundary, and some countries rely heavily on these shared resources (see map O.3). Some 60 percent of surface water resources in the region are transboundary, and all countries share at least one aquifer. The greatest risks arise when countries have both a high percentage of water originating outside their borders and a high reliance on those shared waters. Climate change presents additional challenges because transboundary agreements are often based on multiyear averages, as opposed to percentages of flows. Thus agreements can come under considerable strain when water availability deviates from historical norms. Constructive, transparent, and equitable relationships over transboundary water resources are essential.

**Fragility and political instability can slow or reverse gains in water security, and water insecurity in turn can compound fragility**.

MAP O.3

## Major Transboundary Aquifers in the Middle East and North Africa




*Source:* International Groundwater Resource Assessment Centre.
*Note:* Aquifer names can be found in the full report.

Forced population displacement significantly increases the difficulty of achieving water security. The influx of refugees can exacerbate demographic pressures on limited water resources, leading to social tensions and increased fragility within refugee communities and between refugees and host communities. In particular, there are risks of sexual and gender-based violence toward women and girls who need to access sanitation, cooking facilities, and water points in refugee camps. Investments in water security can help break this vicious cycle of water insecurity and instability and contribute to stability and resilience (Sadoff, Borgomeo and de Waal, 2017).

## Transforming Water: Opportunities and Solutions for Water Security

**Technological and governance innovations—in the region and globally—are accelerating to meet an urgent need for action**. Some of the most notable water management innovations in the world are being implemented in the Middle East and North Africa. These innovations include highly successful efforts to increase water use efficiency along with state-of-the-art water recycling and policies that have successfully reallocated water from low- to high-value uses.

**A range of new technologies for water resources management and water service delivery are available to promote efficiency**. Smart metering, in particular, can be used to improve accuracy in billing, evaluate consumption and increase users' awareness of their own consumption. As experiences from the region and globally show, smart metering also helps water service providers identify leaks, reduce operating costs, and communicate the value of water to users.

**Technology also helps to improve water service delivery, especially for the underserved and the poor**. Mobile-based systems ensure improved customer service by allowing for real time monitoring of water infrastructure. This is particularly important for identifying and fixing operational issues in rural areas where the status of water infrastructure may be difficult to monitor. Furthermore, mobile technologies promote rapid access to information and data sharing, creating a system of accountability. In turn, this strengthens public participation and promotes a more equitable and transparent allocation of the resource. Finally, evidence from different parts of the world shows that the introduction of mobile water payment options improves collection efficiency and increases utilities' revenues, providing financial strength to extend services to the underserved.

**Technologies and practices to recycle water and curb waste are increasingly being used in the region**. Several countries have recognized the benefits of recycling water; some aim to recycle all of their wastewater by 2030. Positive experiences in Jordan (As-Samra) and Tunisia (Souhil Wadi) show that wastewater can be safely recycled for use in irrigation and managed aquifer recharge. Recent decreases in the cost of desalination and advances in membrane technology also mean that desalination is increasingly becoming a viable alternative to traditional freshwater resources.

**Innovations in Integrated Urban Water Management can contribute to improving the quality, reliability, and sustainability of urban and agricultural water services**. Integrated urban water management considers the city's urban water services in close relation with its urban development dynamics on the one hand, and with the broader basin context on the other (World Bank 2012). These approaches have been tried, tested, and scaled in many water-scarce regions in the world. Such approaches will encourage cities to create strong synergies within or outside the water basin—for example, through the development of wastewater recycling for agriculture or shared desalination with industries.

**Water security also requires moving toward a diversified water management portfolio**. Diversified solutions lead to greater resilience to systemic shocks—be they climatic or economic. This starts with "closing the water resources loop" rather than thinking of water usage as "once through the system." Examples of diversification include optimizing local surfaces as well as groundwater storage; developing nonconventional water resources, such as desalination, recycling and recharge; reducing leakage, and promoting conservation.

**Increased institutional coordination among the water, energy, and agricultural sectors is strengthening water management efforts**. Successfully reducing water use and reallocating water to higher value uses requires coordination between different ministries, increased regulatory clarity, and data sharing. Around the world, successful water management is happening in concert with policies that consider also energy and agriculture.

**Experiences from the region show that it is possible to implement the right incentives to encourage water savings and reallocation**. These incentives can be developed in a way that avoids disproportionate impacts on the poor as well as social unrest. Well-designed incentives include accurate targeting of price changes—for instance, by

targeting higher consumption users—and public campaigns explaining the reason for pricing changes and the availability of compensatory mechanisms.

**Public-private partnerships have also been implemented in the region to tackle the operational constraints of water utilities**. The Middle East and North Africa has been the most active place in the world (along with China) regarding public-private partnerships in water management. This has led to improved utility performance over the last six years. Across the region almost 28 million people now have improved water services via public-private utility partnerships.

**There is an increasing role for private sector financing of water infrastructure**. Most of the public-private partnerships in the region have focused on service efficiency. Now there is growing interest in mobilizing private capital to meet the tremendous financing needs for water infrastructure. Wastewater treatment plants in Bahrain, Egypt, Jordan, and the Islamic Republic of Iran, along with irrigation projects in Morocco, show that the private sector is motivated to bring financing to public-private partnerships and to work toward creditworthy water utilities that could attract more private sector financing when issues of tariffs, partial subsidies, and assurance of payments are addressed.

**Achieving water security means acting together, from the household level to the regional level**. From a household water perspective, this means engaging women, who often have the main responsibility for using and conserving water. Women's rights, representation, and resources need to be acknowledged and addressed, both for social inclusion and for sustainable development. Youths should also be engaged in developing the next generation's water expectations and practices.

**At the regional level, cooperation on water can foster greater trust and collaboration**. The World Bank is supporting regional cooperation across the Middle East and North Africa. As part of its regional strategy, the World Bank is promoting regional cooperation around water and other regional public goods and sectors, such as energy and education. The purpose of this action area is not to promote cooperation for its own benefits, but as a means to greater peace and stability in the region (Devarajan 2015). The efforts of the League of Arab States to strengthen water management in the region need to continue. The work by the Arab Countries Water Utilities Association (ACWUA) on benchmarking

water utilities and tracking performance of water services across the region will become more valuable as part of the SDGs. Similarly, collaboration between researchers and universities through established and emerging networks, such as the Middle East and North Africa Network of Water Centers of Excellence (MENA NWC), is essential. Finally, nongovernmental organizations (NGOs), such as the regional Israeli, Palestinian, and Jordanian NGO EcoPeace Middle East, and international organizations can contribute with knowledge and financial resources to help Middle East and North Africa countries and economies address some of their water challenges.

**Engaging and educating civil society on water issues and water conservation is also crucial to guarantee success**. Changing water management practices to ensure better service delivery and sustainability of water use requires changing the attitudes of individuals and government officials, as much as putting in place institutional incentives and arrangements. Promotion of water conservation in schools is just one potential mechanism to change people's awareness and attitudes about water, alongside media campaigns to raise awareness about water challenges.

**While the opportunities and experiences presented here can serve as points of entry for action, solutions will be context-dependent**. There is a rich menu of technological, financial, and institutional options, but the right actions will be different for any particular country, river basin, or city. This is because of the diversity of environmental, economic, and sociopolitical characteristics in the Middle East and North Africa. Some interventions will need to be prioritized during times of protracted crisis, as opposed to interventions and investments that can be carried out during times of post-conflict development. Given the scale of the disruption caused by conflicts, and the protracted nature of some of the region's crises, the traditional approach of waiting for conflicts to end before carrying out reconstruction plans will not work (Devarajan 2015). As discussed in the World Bank's regional strategy, the Middle East and North Africa region requires a dynamic approach that brings in external partners, leverages large scale financing, and moves beyond humanitarian response to longer-term development wherever and whenever conflict subsides.

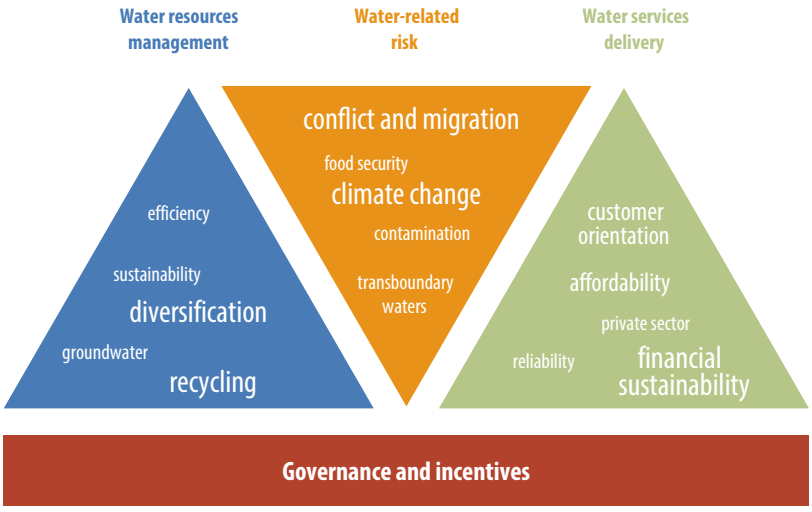
**The region demonstrates a host of potential solutions to its water management challenges, but clear, strong incentives are needed to spur action**. Incentives for water conservation and innovation are needed

to change the way water is managed. These can come through policies, pricing, allocation, or regulation. If water becomes unavailable, or too expensive, water users will respond. They will innovate. They will find better ways of doing more with less. They will adopt proven solutions and adapt or create new solutions.

**The most important lesson from global and regional experience is that technology, policy, and institutional management must evolve together to achieve water security**. Strategies that seek to "desalinate their way out of water insecurity" have made limited progress toward water security. Global experience shows that countries and cities that have arguably overcome the limits of water scarcity have done so through integrated management of both water resources (conventional and non-conventional) and water services and mitigation of water-related risks (figure O.12). This has allowed them to effectively surpass the constraints of their scant natural water endowments. These cutting-edge water managers are effectively aligning water resource planning, management, institutions, information systems, infrastructure, risk management, and incentives to access and store more water, allocate it more efficiently, and deliver it more effectively to customers. And they have done so while guarding the quality and sustainability of their water resources.

FIGURE O.12

**Governance and Incentives to Seize Emerging Opportunities in Water Resources Management and Water Services Delivery and Mitigate Water-related Risks in the Middle East and North Africa**



**Failure to seize these opportunities will have significant implications for the political, economic, and environmental stability in the region and beyond**. As the current conflict and migration crisis unfolding in the Middle East and North Africa shows, failure to address water challenges can have severe impacts on people's well-being and political stability.

**The strategic question for the region is whether countries will act with foresight and resolve to strengthen water security, or whether they will wait to react to the inevitable disruptions of water crises**.

## Notes

1. Water stress arises when water withdrawals for human, agricultural, and industrial uses are relatively high compared to the level of renewable water resources—that is, the ratio of water withdrawal to water availability is high.
2. Pricing refers to a fee to cover the costs of service provision.

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