

# Chapter 3

## Water and Food Security in the Middle Eastern and Northern African Countries



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**Abstract** Water, both for human use and agriculture, is a concern in the Middle Eastern and North African economies (MENA), entailing risks and opportunities in these countries. Besides, fast-changing politico-socio-economic and environmental conditions make water security challenging for policymakers. Water security, coupled with food security, has become a distinct and more unnerving challenge than ever before. This chapter provides a detailed analysis of water scarcity, food security, and climatic challenges in MENA countries and provides a way forward in addressing these issues. In MENA countries, water shortage, food security, and environmental problems are intertwined. It is imperative to use water resources efficiently to ensure a sustainable environment, efficient (allocative) use of water, and obtain distributive justice, contributing to social contract or integration. This argument also includes delivering water input reliably and affordably to ensure cordial relationships between service providers and water users and help promote the renewed social contract. The climate of MENA is arid and near arid. The drought cycle is shortened from three years to annual and often brings floods. Thus, water security, food security, and environmental issues are more than ever-changing targets; however, some are within reach of humankind. A series of suggested solutions to the MENA region's water resource management and associated problems exist. Implementing these solutions needs clear incentives to bring about water management changes, including conservation, allocation, and address some of the riparian issues and water conflicts among the MENA countries, such as the Nile and other basins. The MENA countries warrant

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better engaging the civil society (e.g., High Aswan Dam in Egypt) and water users, teaming millions of youths to make the solution work. The debacle of doable policies addressing water challenges can severely affect nations' well-being and fragile political stability. Thus, the strategic question is 'now or never.' The MENA countries should act with urgent attention in strengthening water security, food security, and a sustainable environment instead of waiting for doomsday for impending water crises leading to 'Water Conflict,' quoting the saying of late United Nations Secretary-General Boutros Ghali that the "*3rd world war will be on waters*".

**Keywords** Food security · Water security · Middle East and North Africa · Water scarcity and strategies

## 1 Introduction

Water and other natural resources, mainly used for agricultural power generation, are under stress globally (Behnassi et al. 2019) due to the exponential rise in income and population, which is increasing the consumption of natural resources rapidly and stretching the entire world to its natural limits (WEF 2016). Besides, climate change further exacerbates the issues of water and food insecurity globally (Scott 2017). The concern is that the three main sectors providing food and income security are also the top greenhouse gas producers and are at risk due to climate change (Scott 2017).

At a global level, 17 countries that provide homes to nearly one-fourth of the entire population face extreme water crises (WRI 2019); out of these countries, 12 are in the MENA region (Hofste et al. 2019). The World Resources Institute (WRI) further concludes that out of 21 countries in MENA, ten are at extreme baseline water stress levels. In contrast, eight are in the high baseline water stress level, which signifies the importance of this region in mitigating water and food insecurity. The MENA region is dry and hot and faces the severe challenge of water shortage with growing water demand. Such a situation further stresses the present water resources, including the capacity of the agricultural sector to meet the region's food security. A report by the World Bank points out that the region can face a significant economic loss (approximately a 6–14% decline in the current GDP) due to water scarcity (Hofste et al. 2019).

Therefore, the concern for energy production, water, food, and climate has become the global agenda due to the exacerbating challenges. Even the United Nations has included the concern for climate as its 13th Sustainable Development Goal (Climate Action). Further, as the data provides that the majority of extremely and highly water and food stress areas are in the MENA region, and the presence of one-fourth population in it, researchers and policymakers find it essential to answer the strategic question of 'now or never.' Moreover, it is imperative for the MENA countries to strengthen water and food security and strive for a sustainable environment instead of waiting for doomsday for impending water crises leading to '*Water Conflict*.'

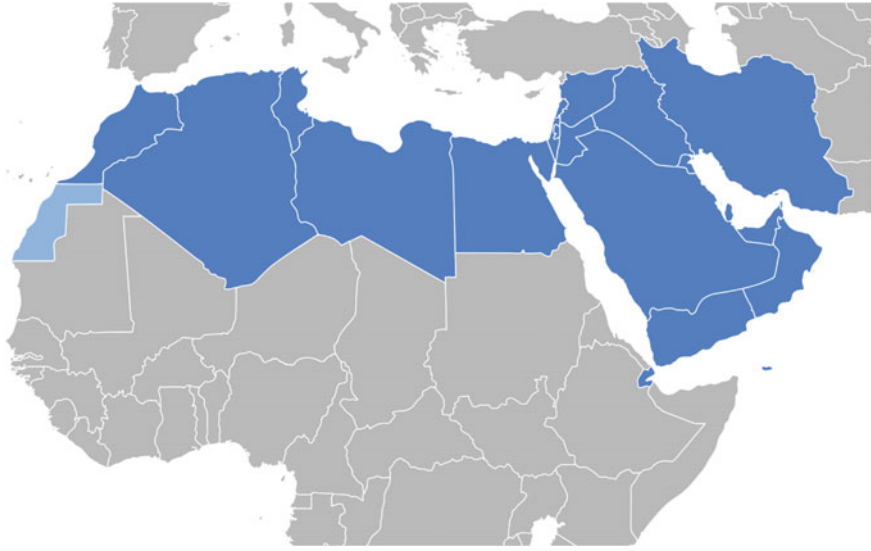
To this end, the present chapter explains the intertwined problem of water and food security as well as the environmental problems in the MENA region. The following sections of the chapter include the background of the MENA region, its geographical area, and utilization, followed by the population and education level. The following section reviews the previous work on the MENA region, followed by the economic state and the political economy. Then, the subsequent section provides evidence on the food and water balance in the region, followed by water conflicts, water management, and strategies to address the water issues. The last section concludes the entire work and provides recommendations for future work.

## ***1.1 Background***

MENA is widely used in the literature to refer to countries in the Middle East and North Africa region (World Bank 2014). The word is often used in broadcasting, military planning, academics, and business writing. The MENA region is diversified, facing economic and political transformations, and striving for better growth. It is in one of the most economic regions of the world with significant access to economics, an increasingly young and educated population, and some competitive advantages in economic sectors such as renewable energies, tourism, and manufacturing (OECD 2021).

## ***1.2 Geographical Area***

As per the definition of Britannica (2021), MENA comprises the countries located on the shores of the Persian Gulf, the Gulf of Aden, and the Red Sea, ranging from the Arabian Sea to the east, the Mediterranean Sea in the south (north in case of North Africa), and the Atlantic shores of Morocco in the west, and encompasses the Arabian, Qatari, and Sinai peninsulas. However, there is no considerate definition of the MENA countries; various global organizations define the MENA region with different countries and territories, and some organizations do not even recognize the MENA region. For instance, the World Bank's 2003 definition of the MENA region includes 21 territories and countries in the Middle Eastern and North African regions (World Bank 2003). These countries include Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Malta, Oman, Palestinian territories (West Bank and Gaza), Qatar, Saudi Arabia, Syria, the United Arab Emirates, and Yemen from the Middle Eastern region and Algeria, Djibouti, Egypt, Libya, Morocco, and Tunisia in the North African region. The 2021's definition of MENA by the World Bank includes the same countries and territories. Figure 1 provides the marked countries in the MENA region by World Bank. Further, the initiative of OECD with the MENA economies includes 19 countries (OECD 2021): Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestinian Authority, Qatar, Saudi Arabia, Syria, United Arab Emirates, and Yemen in the



**Fig. 1** MENA region by the World Bank. *Source* World Bank (2003, 2021)

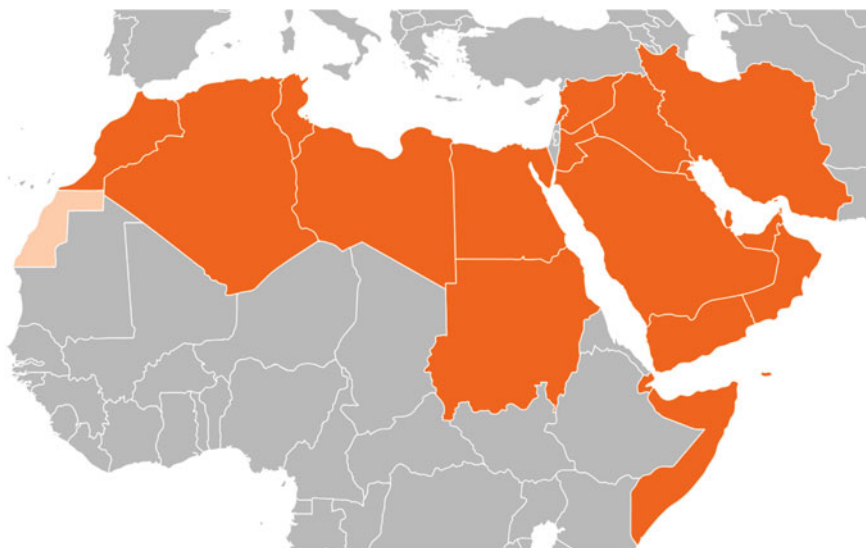
Middle Eastern region and Algeria, Djibouti, Egypt, Libya, Mauritania, Morocco, Tunisia in North Africa.

In contrast to the World Bank's definition, the FAO's 2015 definition excludes Iraq and Malta from the MENA region. In contrast, the OECD-FAO 2018–27 outlook report<sup>1</sup> includes Iraq, Mauritania, and Sudan, excluding Malta, Israel, and Djibouti from the MENA region. Other than this, the International Monetary Fund (IMF) and other organizations of the United Nations, such as the UNAIDS, UNICEF, UNHCR, and UNSD, define the difference between some countries. For instance, UNAIDS, UNICEF, and INHCR omit Israel in MENA, UNAIDS omits Palestinian territories, while UNHCR and IMF include Mauritania and Pakistan (IMF only) in the MENA. Figures 2 and 3 provide the marked countries in the MENA region by UNAIDS and IMF.

### 1.2.1 Middle Eastern Countries

As per the World Bank's definition of the MENA, 15 countries are in the Middle Eastern region (World Bank 2003). The region is located on the shores of the Mediterranean Sea and encompasses the Arabian Peninsula. A brief description of each country is provided below (Britannica 2021).

<sup>1</sup> OECD-FAO Agricultural Outlook 2018–2027: Chapter 2: Middle East and North Africa – Prospects and Challenges. (For more: please see [http://www.fao.org/publications/oecd-fao-agricultural-outlook/2018-2027/en/?\\_cf\\_chlaptcha\\_tk\\_\\_=pmd\\_o0zL5dijz70GPQO2.r6nGwNbXS20pUszJFcvUfGrAx8-1630928220-0-gqNtZGzNAvujcnBsZQR9](http://www.fao.org/publications/oecd-fao-agricultural-outlook/2018-2027/en/?_cf_chlaptcha_tk__=pmd_o0zL5dijz70GPQO2.r6nGwNbXS20pUszJFcvUfGrAx8-1630928220-0-gqNtZGzNAvujcnBsZQR9)).



**Fig. 2** MENA region by UNAIDS. *Source* UNICEF (2019)



**Fig. 3** MENA region by IMF. *Source* IMF (2003)

## 1.2.2 North African Countries

Likewise, the World Bank's definition includes six countries from Africa in the North African region of MENA (World Bank 2003). The region locates on the Atlantic shores of Morocco in the west and the Red Sea in the east. A brief description of each country is provided below (Britannica 2021).

## 1.3 Resource Utilization

The geographic location and the abundance of natural resources make MENA one of the most critical regions of the world, affecting the stability of the rest of the economies (OPEC 2012). The utilization of natural resources in the MENA region is diversified. The below section explains the primary natural resources distribution, such as land, labor, capital, finances/FDI, oil, and agriculture in the MENA region.

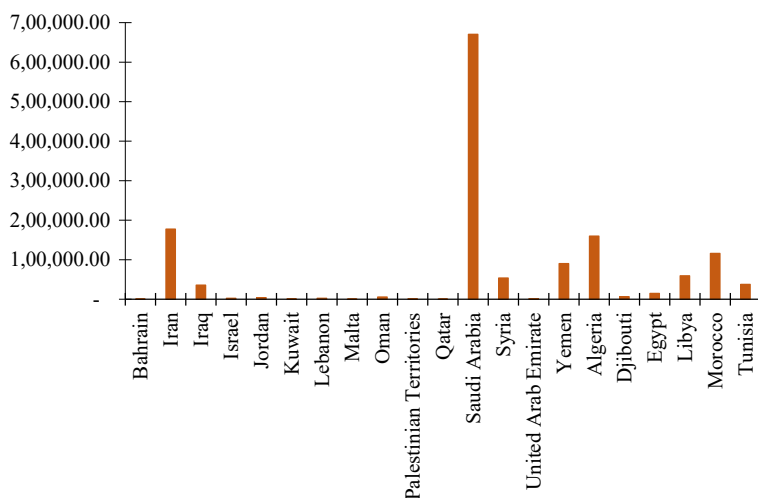
### 1.3.1 Land

As per the World Bank (2018a) data, the total land area of the MENA region is 4,333,359.28 sq. miles: 4,108,957.64 sq. miles of rural and 100,890.64 sq. miles of urban land (World Bank 2010). However, FAO (2021) points out that out of the available land, only 1/3 (33.22%) supports agricultural production, out of which only 5% is arable. The remaining land makes up deserts or is utilized under urban settlements. Besides, the total land under forest has increased from 80,512.73 sq. miles in 2000 to 88,517.36 sq. miles in 2018 (World Bank 2018a).

### 1.3.2 Land for Agriculture

MENA is one of the most challenging regions of the world due to its location and the environment, making it unsuitable for agriculture. The statistics provide that the total land available for agriculture is 1,438,533.59 sq. miles, the highest in Saudi Arabia (670,382.24 sq. miles) and the lowest in Bahrain (33.20 sq. miles). Figure 4 provides the detailed availability of land for agriculture in each country (World Bank 2020).

Besides the dearth of suitable agricultural land, the productivity of land under cultivation has reduced to only 35–30% (FAO 2021). Box 1.1 provides the recent initiatives to address the issue of declining land quality in the MENA region. The primary sources of land degradation are water and wind erosion (removal of the uppermost layer) in rain-fed areas and soil salinity/sodicity and intensive farming in irrigated land areas (FAO 2021).



**Fig. 4** Land available for agriculture (square miles). *Source* World Bank (2020)

### **Box 1.1 Initiatives combating the declining land quality in the MENA<sup>2</sup>**

Considering the issue of declining productivity in the MENA region, the following two solutions can provide benefits to meet the productivity level.

- (a) *Soil Maps*: These documents provide information on soil characteristics, such as soil nutrients, water storage electrical conductivity, soil pH, and organic material. The data is collected in various ways, such as manual field sampling, infrared spectroscopy, and remote sensing. Thus, the information can provide crucial information to farmers and policymakers to decide which crop to plant/sow and how much inputs such as seeds, water, and organic and synthetic fertilizers are required. However, soil maps may bring problems in decision-making if outdated or low-resolution soil maps are utilized.
- (b) *Zero Tillage*: This technique helps mitigate the issue arising from the plowing, such as loss of upper layer (organic matter) and moisture which can further pace the water and wind erosion. This technique minimally disturbs the upper layer of the soil. The roots left from the last crop serve the role of soil stabilizer, increasing the fertility and water-holding capacity. Thus, the technique can help maintain land productivity.

<sup>2</sup> Source: [http://www.fao.org/3/i9166e/i9166e\\_Chapter2.pdf](http://www.fao.org/3/i9166e/i9166e_Chapter2.pdf), cited in OECD-FAO Agricultural Outlook 2018–2027.

### 1.3.3 Aquaculture and Fisheries

Due to the presence of the majority of the MENA countries on the shores of the seas, fisheries and aquaculture have greater importance. The region provides one of the most diversified freshwater and marine ecosystems, and it provides livelihood to the locals and services as the source of a nutritious diet. As per the stats provided by FAO (2021), total production from freshwater, marine, and aquaculture included 59 million tons in 2016, which increased from 2.2 million tons in 1996, mainly due to the increase in the captured fisheries. In contrast, during the same time, aquaculture also increased (32% share in 2016). However, regardless of the region's production, it still relies on imports of fish and fish products to meet its national consumption (FAO 2021).

### 1.3.4 Labor

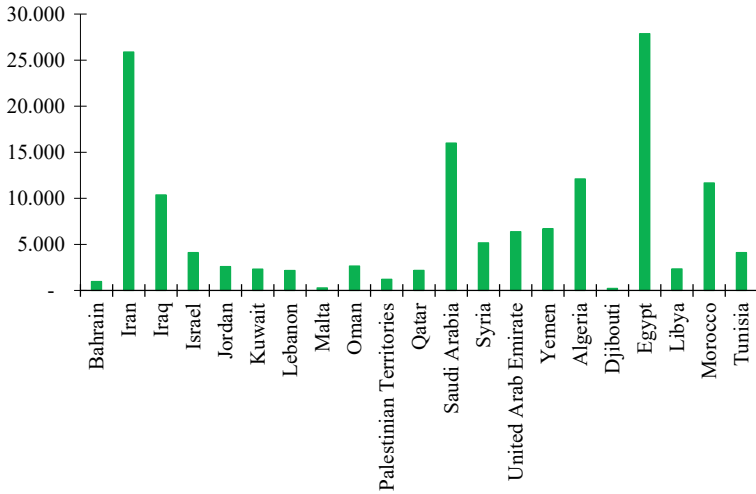
As per the World Bank 2020 data, the total available labor force is 147.277 million out of the 464.554 million population in the region (World Bank 2020); the highest in Egypt (27.870 million labor, 102.334 million total population) and the lowest in Malta (0.280 million labor, 0.525 million total population). The data shows that, on average, 19.93% are females (highest in Israel, 47.6 percent; lowest in Yemen, 7.9%), and the remaining are males (80.07%). Besides, 14.597% are employed in agriculture (highest in Morocco, 33.25 percent; lowest in Israel, 0.92%), 26.96% in industry (highest in Qatar, 54.00 percent; lowest in Yemen, 10.20%), and 58.29 percent in the services sector (highest in Israel, 81.86%; lowest in Morocco, 43.66%). The data provides that labor participation in the agricultural sector has decreased over the period, sustained in the industry, and increased in the services sector (World Bank 2021). Figures 5 and 6 provide the detailed availability of labor for each sector in each country.

### 1.3.5 Capital, Finances, and Foreign Direct Investment

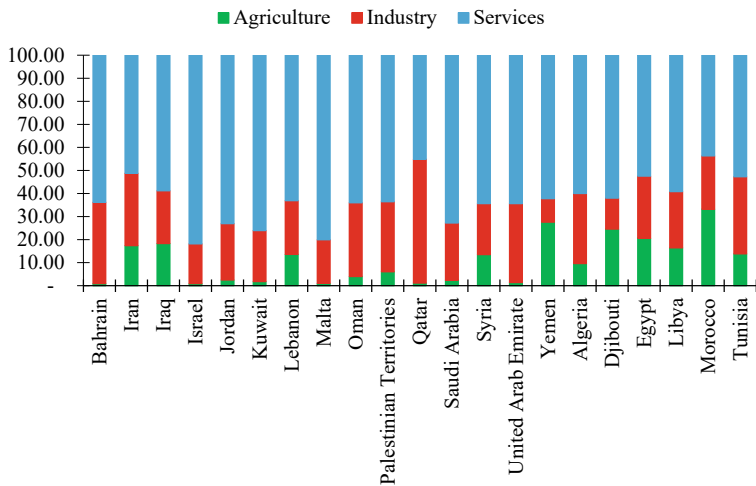
The MENA region has remained vital in attracting media attention as one of the most critical hotspots for economic, security, and political vulnerabilities (Miller et al. 2018). In terms of finances and wealth, the countries located in the region are also diversified, ranging from wealthy countries with one of the top natural reserves, such as crude oil, to the poorest economies extravagated by poverty and chronic battles. These issues in developing countries hinder investment from multinational companies (MNCs) operating in the region (Dimitrova et al. 2019). As per the World Bank (2020), the present FDI<sup>3</sup> in the entire region is 66.074 billion USD (highest in Israel—24.283 billion USD, lowest in Libya—0.001 billion USD, and negative in Yemen, Kuwait, Qatar, and Iraq), which once reached an all-time high of 126.452

<sup>3</sup> Foreign direct investment, net inflows (BoP, current US\$) – Middle East & North Africa.





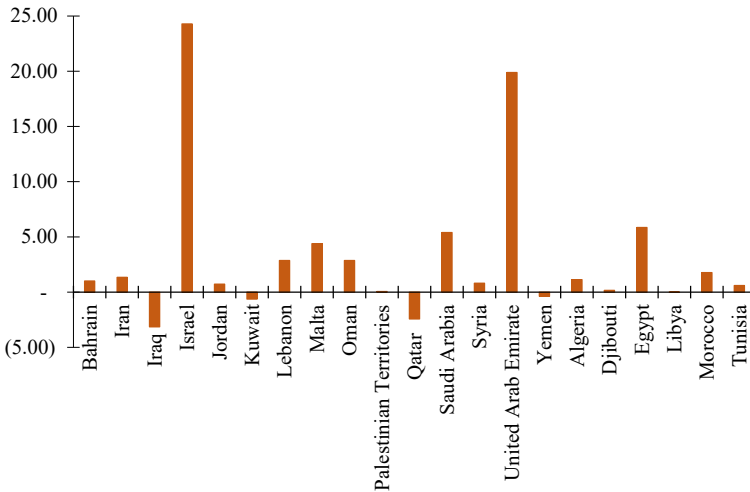
**Fig. 5** Total labor force (Millions). *Source* World Bank (2020)



**Fig. 6** Total labor force in each sector (percentage). *Source* World Bank (2020)

billion USD in 2007. Figure 7 provides the detailed availability of the FDI in the MENA region.

The present investment (growth and decline) in the MENA region has declined due to chronic fiscal and structural problems, primarily improper infrastructure, prevalent corruption, feeble governance, frail private sector vitality, and inadequate economic divergence outside the oil sector. It has further been exacerbated by the drastic decline



**Fig. 7** Foreign direct investment (millions). *Source* World Bank (2020)

in oil prices<sup>4</sup> and the fallout from the Arab Springs uprisings (World Bank 2018a; Saefong 2021). Besides this, the region is also facing political instability coupled with humanitarian disasters, making them least integrated into the world economy despite the presence of two primary trade routes (World Bank 2018b). These issues lead the MENA region to poor economic development and lower FDI (Dimitrova et al. 2019).

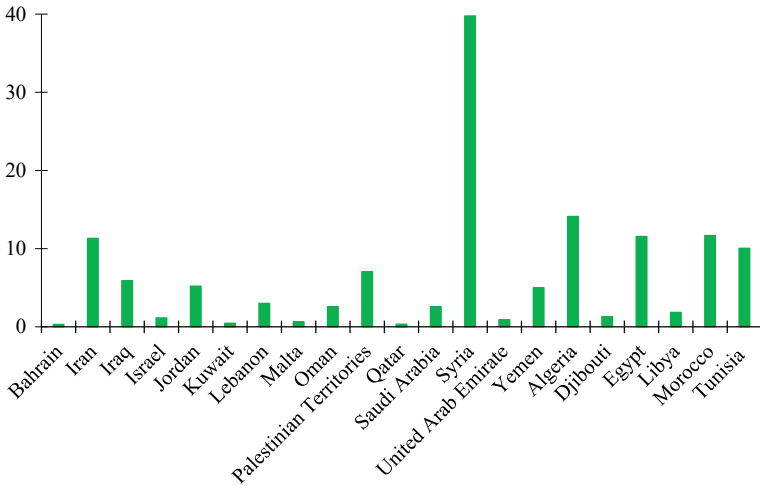
Contrary to the present scenario, the MENA region can still attract local and foreign investment due to the presence of natural reserves (gas and oil), the growing young population, and the geopolitical presence (Demirbag et al. 2011).

### 1.3.6 Agriculture

Similar to the diversified nature of labor force employment, the agricultural sector's contribution to the national economy is diversified (Ahmed et al. 2023). For instance, the agriculture, forestry, and fishing value added to the region's GDP are 5.165%; the lowest in Bahrain (0.31%) and highest in Syria (39.77%). It points to the importance of agriculture in minor oil-producing economies such as Yemen and Syria and lesser importance in most oil-producing economies such as Qatar, Bahrain, and Saudi Arabia. Figure 8 provides the detailed contribution of agriculture, forestry, and fishing in each country (World Bank 2020).

Regardless of the contribution of agriculture to MENA's economy, it plays a vital role in providing raw materials to the manufacturing and servicing industries (Lechtenberg 2018). The irrigation system, mainly in the basins of the Tigris-Euphrates

<sup>4</sup> For more, please see: <https://www.bbc.com/news/business-52350082>.



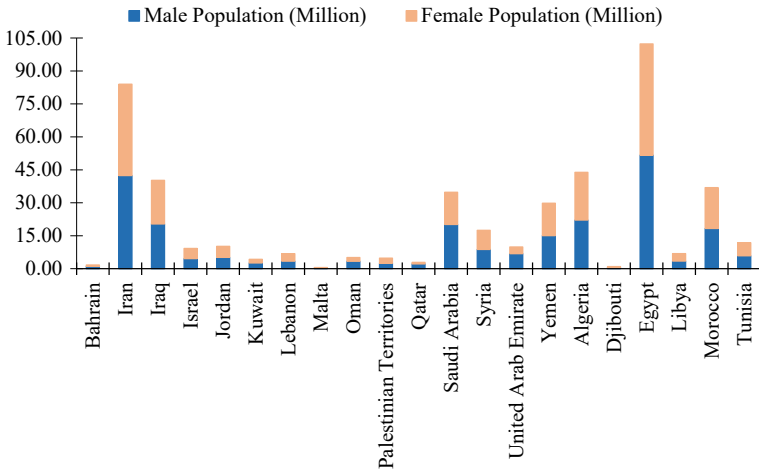
**Fig. 8** Agriculture, forestry, and fishing value added (% of GDP). *Source* World Bank (2020)

River Basin, Jordan River Basin, and Nile River Basin, enables the intensive production of crops, supporting the exports of valuable fruits, cereals, and vegetables. However, the food gap in the entire region is broadening, questioning the food security of the MENA economy. Some countries have now focused on increasing agricultural production by introducing policies. For instance, Saudi Arabia’s Vision 2030 focuses on food for all populations living in the kingdom by increasing aquaculture, cooperatives, and vegetable and fodder productivity (SPA 2021).<sup>5</sup>

**1.3.7 Crude Oil Production**

The MENA countries are known for their vast crude oil reserves globally, producing 30.80 million barrels per day. The leading exporter of crude oil and products are Saudi Arabia (also the second-largest oil exporter globally), exporting 12 million barrels per day, followed by Iraq (4.8 million barrels per day), UAE (4.0 million barrels per day), Iran (3.2 million barrels per day), and Kuwait (3.0 million barrels per day). In contrast, Syria is the lowest, with 0.024 million barrels per day (Carpenter 2021). However, oil production is decreasing gradually, and the economy is shifting toward other sources to generate income. The above-given Fig. 4b also identifies the shift in labor participation toward the services sector in the MENA region.

<sup>5</sup> For more: Please refer to: <https://www.spa.gov.sa/viewstory.php?lang=en&newsid=2290104>.



**Fig. 9** Total and gender-specific population (millions). *Source* World Bank (2020)

## 2 Population and Education Level

The population is considered an essential factor in determining the country’s growth due to its high role in the labor force. This section explains the population in each MENA economy and their education level.

### 2.1 Population in the MENA Countries

The population level in the MENA region provides that the countries are highly populated, housing 6.3% of the global population. As per the data provided by World Bank (2020), the population in the MENA region is 464.554 million (240.679 million Males, 223.874 million Females). Out of this, 396 million (199 million Males, 196 million Females) live in lower and middle-income<sup>6</sup> countries, which intensifies the population and income inequality in the region. Nevertheless, the population level is highly diverse in MENA, as Egypt (22.03%) and Iran (18.08%) alone encompass more than 40 percent of the region’s total population. Figure 9 depicts the gender-specific population in each country.

<sup>6</sup> Data extracted from Population, total – Middle East and North Africa (excluding high income countries). Source: [https://data.worldbank.org/indicator/SP.POP.TOTL?locations=ZQ&most\\_recent\\_value\\_desc=true](https://data.worldbank.org/indicator/SP.POP.TOTL?locations=ZQ&most_recent_value_desc=true).

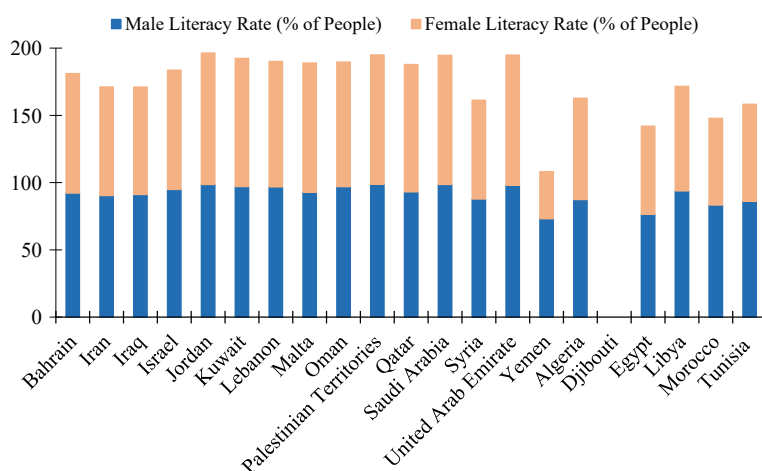
## 2.2 Education Level in the MENA Countries

The education level in MENA provides that the average adult literacy rate in the region is 79.649% (highest in Saudi Arabia, 97.59%, and lowest in Yemen, 54.10%). In contrast, the average youth literacy (15–24 ages) rate is 90.331 percent (highest in Saudi Arabia, 99.50%, and lowest in Yemen, 77.00%). Figure 10 provides the MENA region's adult, gender-specific literacy levels.

In relevance to the education level in the MENA region, these countries share some cultural links and distinctions from the nearby economies. For instance, the culture in Israel is different from the culture in Turkey. The same applies to Iran, Saudi Arabia, Egypt, and Morocco. Similarly, Islam is the dominant religion in the region except for Israel, and Arabic is the primary language except for Iran, which has Persian as the primary language.

## 3 Previous Work in the MENA Region on Water and Food Security

The water and food security of any region/country depends on agricultural and other development practices, climate change, and environmental resources (Antonelli et al. 2017). Various studies have determined the adverse impact of water and food security in the MENA region, encompassing 6.3% of the global population and less than 2% of the total renewable freshwater availability. For instance, Williams (2015a, b) investigated the failure of investments in the agriculture sector to meet food and water



**Fig. 10** Total and gender-specific literacy rate (% of people). *Note* The latest data for Yemen is from 2004, whereas no data is available for Djibouti. *Source* World Bank (2020)

security. The results show that large-scale investments in the agricultural sector are required to meet food and water security. Antonelli and Tamea (2015) examined the food and water security in the region by undertaking the political economy perspective. The results highlighted that the food and water security of the region depends on importing the food and water (moisture content in food products).

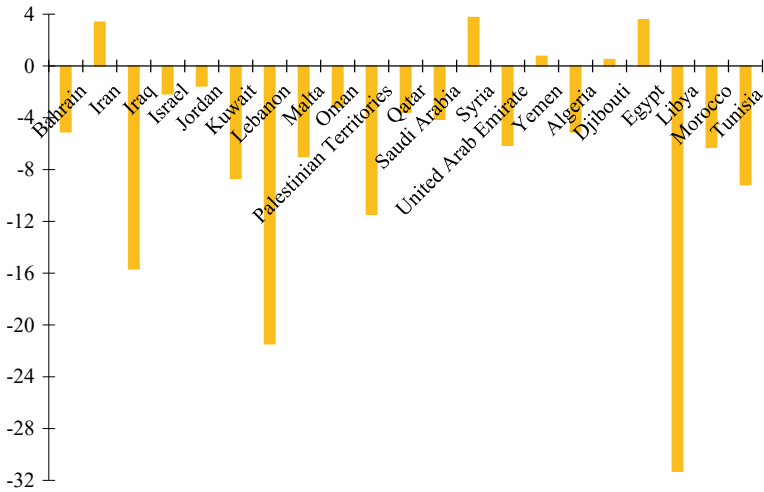
Specifically, on water security, Gürsoy and Jacques (2014) mentioned that the water security of the MENA changed drastically in the last few decades due to the political conflicts extended over decades. Despite the political governments' focus on the supply side of water conservation, building dams and water reservoirs has escalated the tensions between neighbors. Section 6.1 focuses on water conflicts in the MENA region. Karadirek (2017) evaluated household-level water security in the MENA region. Based on the Asian Water Development Outlook (AWDO) methodology, the authors defined the household level water security for water access, sanitation access, and hygiene. The results depict that households in Algeria, Egypt, Jordan, Lebanon, Morocco, Tunisia, Turkey, and Yemen are highly vulnerable to water scarcity.

From the food security perspective, Omidvar et al. (2019) assessed the food security and socio-demographic factors affecting food security in the region. The results pointed out that 5% of people in rich countries and 13.6% in lower-middle-income countries were facing the issue of severe food insecurity. Wright and Cafiero (2010) mentioned that the MENA region largely depends on grain imports, which are unreliable. Besides, the heavy subsidies on grain consumption by both rich and poor reduce the stabilizing response of consumption to price and increase the size of reserves needed to ensure any given level of food security.

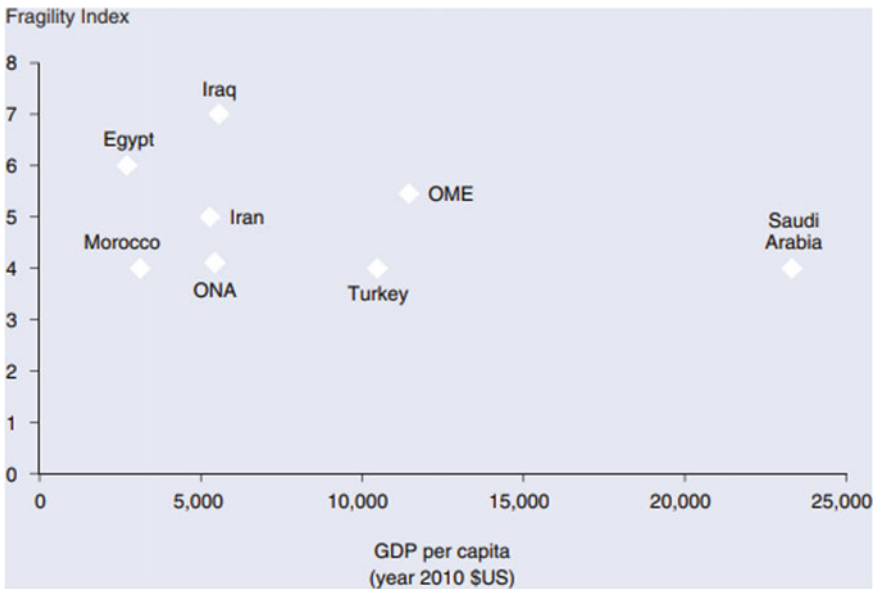
## 4 State of the Economy

The MENA region comprises a heterogeneous group of countries, encompassing high-income countries to middle-income and lower-income countries. The region is highly dependent on oil and gas production in the high-income economies and on agriculture in the middle-and-lower-income economies. Due to this, the region is in unstable economic growth. For this, let us look at the present GDP growth rate in the MENA region. World Bank (2020) data provides that the region is currently experiencing overall negative GDP growth of  $-3.988\%$ , with the highest in Libya ( $-31.30\%$ ). Some countries also experienced growth, such as Egypt ( $3.57\%$ ) and Syria ( $3.75\%$ ). However, the average growth rate may reach  $4.6\%$  in 2023. Figure 11 provides the most recent data on the GDP growth rate in the region (IHS Markit 2021). Besides, Fig. 12 provides the political and income status in MENA.

Digging deeper into the region's economy, it still gets  $7.94\%$  of its GDP value-added from agriculture, forestry, and fishing, with the highest in Algeria ( $14.2\%$ ) and lowest in Qatar ( $0.3\%$ ). Likewise, the region's manufacturing value added to the GDP is  $12.34\%$ , the highest in Algeria ( $24\%$ ) and the lowest in Iraq ( $2\%$ ). In contrast, the sector still largely relies on the manufacturing sector's value



**Fig. 11** GDP growth rate (percentage). *Source* World Bank(2020)



**Fig. 12** Political stability and income of MENA countries. *Source* Getachew and Mesbah (2015)

in addition to the GDP. It gets around 35.49%, the highest in Kuwait (58.4%) and the lowest in Lebanon (7.2%). Lastly, like the rest of the world, the services sector's

contribution to GDP is rising in the region as it contributes around 55.29%, with the highest in Lebanon (86.4%) and the lowest in Algeria (47.8%).<sup>7</sup>

From another perspective, Al-Shaikh and Jamal (2020) provide that the region largely relies on exporting raw products as a source of foreign exchequer. Besides, the dependence on foreign markets is high as a source for industrial and food products. The over-dependence of the region has raised the question of growth and employment.

To cater to this need and defend common interests, the countries located in the region are also part of several unions and cooperatives. For instance, North Africa is part of the African Union, Algeria, Bahrain, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Syria, Tunisia, the United Arab Emirates, and Yemen are part of the Arab League. Besides this, Saudi Arabia is a member of the G-20 nations, Algeria, Egypt, and Iran are part of the G-15 nations, whereas Israel is part of the OECD<sup>8</sup> countries. Lastly, Algeria, Iran, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, and the United Arab Emirates are part of the OPEC<sup>9</sup> countries.

## 5 Food Balance and MENA

From the food balance perspective, it is imperative to understand the need for food security in the MENA region. The following section provides old and new perspectives on food security in the world, followed by a detailed section on the current scenario in the MENA region.

### 5.1 Food Security

Traditionally, Bindraban et al. (1999a, b) defined food security as when all the time, an individual has access to food in the required quantities that can enable him to live a healthy and active life. The definition is also accepted globally to explain food security. However, this definition of food security based on the production-orientation approach has gradually changed towards the integrated-orientation approach, which now imitates the various components of food security. Therefore, the most recent definition of food security involves availability, equal access, stability, and quality food. Food security will likely be achieved when all of these factors are available (Mbow et al. 2019). Food security, as per the updated definition, has four components: (i) physical availability of foods, which addresses the “*supply side of food security and is determined by the level of food production, stock levels, and net*

<sup>7</sup> To provide the better picture of the region, the data of the warn torn countries such as Yemen, Libya, and Syria have not been considered by the authors.

<sup>8</sup> Organization for Economic Cooperation and Development.

<sup>9</sup> Organization of the Petroleum Exporting Countries.



trade”; (ii) economic and physical access to food, which ensures “an adequate supply of food at the national or international level; however, it does not in itself guarantee household level food security”; (iii) food utilization, which addresses the “sufficient energy and nutrient intake by individuals as a result of good care and feeding practices, food preparation, diversity of the diet and intra-household distribution of food”; and (iv) stability of the other three components over time, which states that “even if one’s food intake is adequate today, he or she is still food insecure if he or she has inadequate access to food periodically, risking a deterioration of his or her nutritional status” (Hameed et al. 2021; World Bank 2023).

Concerning food security in the MENA region, there is a need to look at cereal production to understand its current level of food security.

### 5.2 Cereal Production in MENA Region

The World Bank (2018) data provides that the cereal production in the region is 70.090 million metric tons, which makes 2.36% of the entire global production (2.965 billion metric tons) for the 6% of the global population. Besides, the per-country total cereal production is also diverse, where only three countries, i.e., Egypt, Iran, and Morocco, collectively produce 75.69% (31.44, 29.44, and 14.81%, respectively) of the region’s total cereals production. Djibouti is at the bottom, producing only 18 metric tons of cereals, whereas Bahrain does not produce any. Figure 13 provides the details of cereal production in the MENA region.

Along with cereals, oilseed crops are another type of crop providing energy and protein in the MENA region.

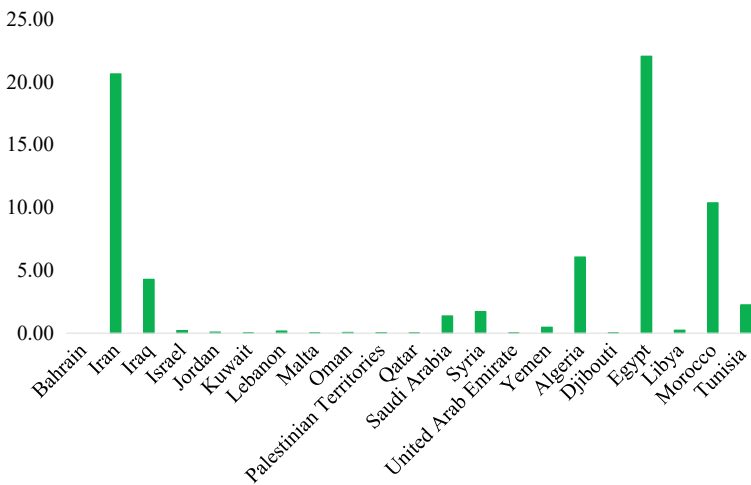


Fig. 13 Cereals production (million metric tons). Source World Bank (2018c)

## 6 Water Balance and MENA

The region is the most water-scare region globally, with only 1.4% of the available freshwater sources housing 6.3% of the entire population (World Bank 2017a). Over 60% of the population in the region has little or no access to drinkable water, while over 70% of the region's GDP is exposed to high or very high-water stress (Al-Zu'bi 2019). The region is also severely affected by climate change and has been subject to an almost continuous drought since 1998. Therefore, water has remained a challenge for the MENA countries (Drake 1997). Nonetheless, this issue is further worsened by ongoing regional instability, climate change, and economic development (World Bank 2017a). These activities will further increase the water demand in the future.

The region is comprised of an area of 4.6<sup>10</sup> million sq. miles, making around 10 percent of the world's total land area (UN-FAO 2014), whereas, in 2020, the region's population reached 464 million with an annual increase of 1.7 percent (World Bank 2018), and expected to reach 586 million by 2030 and 732 million by 2050. It is pertinent to mention that a larger population will require more water. Based on the available water in the region, MENA can be divided into five primary subdivisions (Kandeel 2019):

- **Arabian Peninsula:** Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, the United Arab Emirates, and Yemen
- **Nile Basin:** Egypt
- **Al-Maghreb:** Algeria, Libya, Morocco, and Tunisia
- **Al-Mashreq:** Iraq, Jordan, Lebanon, the Palestinian Territories, and Syria
- **Sahel:** Djibouti.

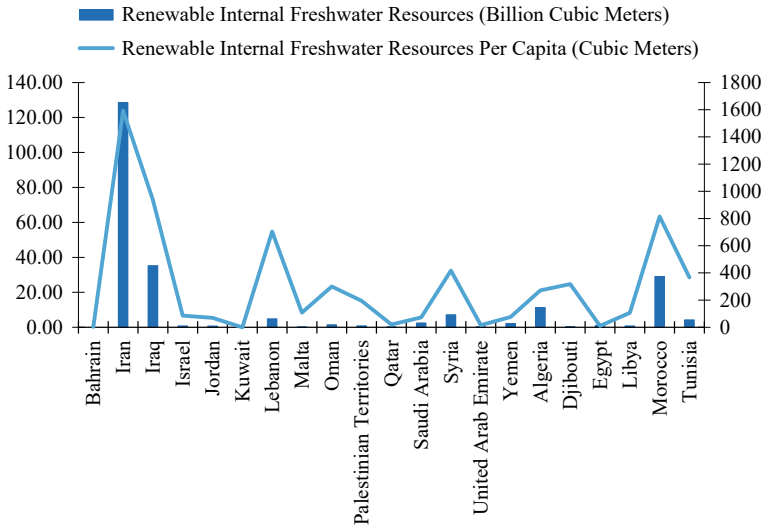
Besides, the al-Maghreb, al-Mashreq, and Nile Basin countries share common climatic attributes, determining their natural water resource capacity (Kandeel 2019). Further, the available renewable<sup>11</sup> internal freshwater resource in the MENA region is 229.67 billion cubic meters (highest in Iran, 129.50 billion cubic meters; lowest in Malta, 0.05 billion cubic meters; and zero in Kuwait, Bahrain). The MENA region's per capita renewable freshwater resource is 525.747 cubic meters (highest in Iran, 1592.83 cubic meters; lowest in Bahrain, 2.68 cubic meters, and zero in Kuwait). In contrast, it is 604.24 cubic meters in the MENA region, excluding the high-income countries, postulating that the lower middle and middle-income countries in the MENA region have more per capita freshwater available for their people (World Bank 2021). Figure 14 provides the available inland and per-capita water in the region.

Besides the inland water availability, the rainfall is meager in the region as it spans over three deserts<sup>12</sup> worldwide. The average annual rainfall in the region is

<sup>10</sup> 1.2 billion Hectares (UN-FAO, 2014).

<sup>11</sup> Refers to internal river flows and groundwater from rainfall in the country.

<sup>12</sup> These three deserts are: (a) Rub'al Khali desert in the Southern Arabia. (b) Sahara Desert in the Africa that includes major part of the Egypt and Libya, and (c) Baidat El-Sham in the Northern Arabia.



**Fig. 14** Renewable internal freshwater resources and per capita (cubic meters). *Source* World Bank (2017b, c)

below 100 mm in 65% of the region, while it is between 100 and 300 mm in 15% of the region; the rest of the area gets more than 300-mm rain annually (Abu Zeid and Abdel-Meguid 2006). Studies on the water conflict and climate change in the region MENA reckon that the water conflict among these countries is escalating due to the worsening climatic conditions. Figure 15 points to the water scarcity in the region.



**Fig. 15** Water-scarce countries in the Middle East and North Africa. *Note* Shaded countries have less than 1000 cubic meters of renewable freshwater per person yearly. *Source* World Bank (2017a)

The scarcity of anything generates conflicts among the stakeholders. The population living in the countries faces a severe water crisis, leading to potentially disastrous consequences (Selim et al. 2020).

## 6.1 Water Conflicts

Despite its most significant importance in human living, water has remained the point of conflict among nations. Several countries in the region are currently in a state of geopolitical instability (Zekri and Al-Maamari 2020). The water issue in the MENA region covers three primary basins, including Tigris-Euphrates River Basin, Jordan River Basin, and Nile River Basin.

## 7 Water Management and Issues

The freshwater withdrawal by the industries<sup>13</sup> in the MENA region is 4.32 percent, which is slightly higher (4.34%) in the lower and middle-income countries. Compared to the industry, the freshwater withdrawal by agriculture<sup>14</sup> in the MENA region is 85.43%, slightly higher (86.04%) in the lower and middle-income countries (World Bank, 2021). Thus, owing to the copious reliance on agriculture in the region, Woertz (2017) argues that agriculture is the primary factor in the water crisis. It withdraws nearly 80% of the total available water.

## 8 Strategies to Address Water Issues

Before addressing the water issues, it is paramount to understand the need for water management. The climate of the MENA region is predominantly hot, and the region widely relies on rain to irrigate lands and produce food for humans and animals. The total and per capita in-land water is also low in coastal or island countries like Kuwait, Bahrain, and Malta. Water scarcity, coupled with water conflicts among countries such as Turkey, Israel, Jordan, and Egypt, put the MENA region at stake. These issues have made water a precious resource from a widely available commodity. To this end, the present governing bodies in the region need to develop water management strategies to address water issues in the region. The below-given paragraphs elaborate on strategies falling into two subsections, i.e., water consumption strategies and water conservation strategies.

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<sup>13</sup> Annual freshwater withdrawal, industry (% of total freshwater withdrawal). Source: World Bank, 2021.

<sup>14</sup> Ibid.

Under the water consumption strategies, the MENA governments must develop the following:

- The first and topmost strategy under water consumption is ‘increasing awareness to change consumption patterns.’ World Bank data reported the decline of per capita freshwater available for the people in the region, mainly in sub-Saharan Africa and the Arabian Peninsula. It implies that water consumption must be conscious of meeting the present and future demands of the population. Therefore, educating people about sustainable water use is paramount to managing the crisis.
- The second strategy, ‘reducing the corporate water footprint,’ implies that industrial water consumption nearly accounts for 22% of global consumption. In the MENA region, it is 4.33% (highest in Lebanon, 48.91%, and lowest in Iran, 1.18%). Therefore, the governments in the MENA region must push industries to adopt sustainable manufacturing practices<sup>15</sup> (focused on less water consumption) to produce goods and services. The examples may include: (i) switching to sustainable and renewable energy resources, such as solar, wind, or biogas, to power the production processes; (ii) reducing industrial waste or efficient recycling of the waste to reduce the carbon footprint; and (iii) improving energy efficient materials and machine parts, such as smart sensors and automation, in production processes.
- The third strategy includes ‘planning for and reducing the population growth rate.’ The population growth rate in the MENA region is 1.718%, implying that the population will increase by 7.98 million yearly, which can post the supply–demand side gap to nearly 65% by 2030. Therefore, reducing the population growth rate will reduce water consumption.
- The last strategy under the consumption strategies includes finding new ways and scaling up innovative water technologies ranging from reusing wastewater, desalination, combined agriculture or aquaculture, and smart irrigation systems. In some countries, more than half of current water withdrawals exceed what is naturally available; 82% of wastewater is not recycled, presenting a massive opportunity to meet water demands (World Bank 2017a). Therefore, finding new ways to recycle would be paramount.

Under conservation strategies, the MENA governments must develop and improve ‘ways to conserve the presently available water’ for its population:

- The first strategy is to invest in ‘inventing new and innovative ways to conserve water in the areas where the aquifers are drying up, and rainwater is increasingly unpredictable.’ Governments can focus on providing grants to universities and research institutions to develop improved water catchment and harvesting methods.
- The second strategy is ‘developing energy-efficient desalination plants for water conservation.’ Presently, desalination is another significant problem in the African continent after food and water security, and the process is costly and energy extensive. Although the Middle Eastern states have developed large energy reserves

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<sup>15</sup> Sustainable manufacturing practices aim to reduce the environmental impact of producing goods and services, while also ensuring social and economic benefits.

to build desalination plants due to their strong economies, North African nations cannot do so. Therefore, governments must fund the development of better water desalination plants to conserve water.

- Other than these two broad strategies, the governments in the MENA region can build institutional cooperation, improve distribution infrastructure, develop better policies, and price water appropriately to address water issues. All will collectively affect water consumption and conservation.

## 9 Conclusions and Recommendations

This chapter highlights the widespread issues of water and food security in the MENA region. The rapid and dynamic changes in political, social, economic, and environmental factors have worsened the water scarcity and food security challenges for policymakers. Both issues are interlinked and pose a more serious and urgent threat than ever before for the future. In particular, water scarcity, climate change, population growth, urbanization, conflict, and displacement are some of the factors that contribute to the challenge of ensuring water and food security for all. The findings from the study suggest that the region has the greatest expected economic losses from climate-related water scarcity, estimated at 6–14% of GDP. Total water productivity in MENA is only about half the world's average, which poses a big question on the current and future economic status of the region. Besides, the region is exceptionally dependent on food imports, especially on wheat and other staple grains. The estimates suggest that the number of Yemenis afflicted by food insecurity reached 24 million— ~83% of the population—in 2021, with 16.2 million needing emergency food. With regard to education, one in every five children in MENA is not in school, and of these out-of-school children, an estimated number of over 3 million would have been in school if the crises had never happened. Equally, by the end of 2017, the armed conflicts in Syria, Iraq, and Yemen brought back the number of regional out-of-school children to its 2007 level of over 14.3 million.

Therefore, policymakers need to adopt a holistic and integrated approach that considers the interlinkages between water, food, energy, and the environment to address these challenges. They also need to foster regional cooperation, invest in innovative technologies, promote water conservation and efficiency, and engage with all stakeholders, especially the youth and women who are most affected by water insecurity. By doing so, the MENA region can turn its water and crisis into an opportunity for peace and prosperity, which may become a case of a “blessing in disguise.”

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## ***Further Reading***

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