SEPTEMBER 2020

WATER IN THE MIDDLE EAST

A PRIMER

BY JESSICA BARNES

The Nile at Luxor, Egypt

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Policy reports, newspaper articles and textbook entries about water in the Middle East often begin in a strikingly similar way. They start with reference to the Middle East's arid environment, perhaps illustrated with an image of a desert, parched surface or person laden with containers for water. Then they pivot to the rapidly growing population, citing alarming figures for how many more people will be inhabiting this arid region in the coming decades. Through this juxtaposition, they frame a crisis as inevitable. When it comes to water, the Middle East is a region of superlatives: the highest proportion of a population exposed to water stress, the least sustainable water resource use, the most water scarce region in the world.

This simplistic narrative contains some truth. Much of the Middle East and North African region is dry, falling into arid or semi-arid zones that receive low and variable rainfall, feature high evaporation losses and face frequent droughts. Cairo receives an average of 18mm (0.7 inches) of rainfall over the entire year. Los Angeles, in comparison, receives 380mm (14.9 inches). As a result of these climatic conditions, there is little surface water. The lines of rivers threading across the map of the region are few and far between. The arid climate also means that where there are stores of water below the surface, those aquifers are not being replenished very quickly. In some cases, aquifers are not being replenished at all; these fossil aquifers date back hundreds of thousands of years to past epochs when the region's climate was wetter. The region may be flanked by plentiful saline waters, which have long played a role in

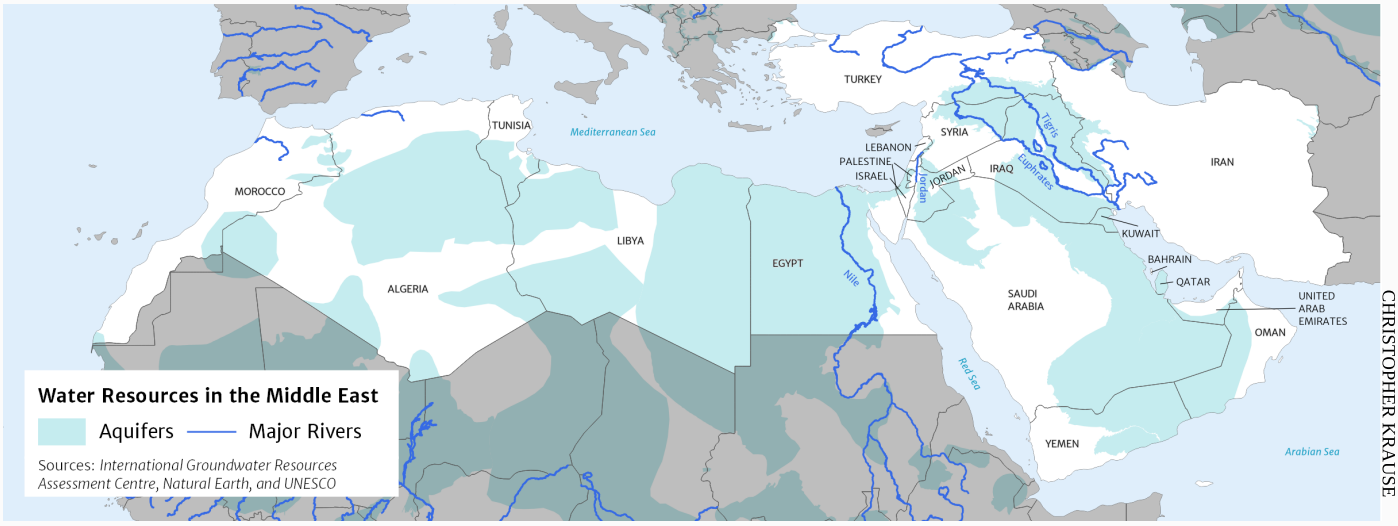
the cultures and economies of the region, but in terms of consumable freshwater, the resources are limited.

This is not, however, the entire picture. The Middle East and North Africa also contains mountain chains where vegetation is lush and winters wet. Morocco's Rif mountains, for example, receive over a meter of rainfall a year (for comparison, that is more than the Adirondacks). Around the Mediterranean Sea, too, climates are milder and rainfall higher. It sometimes snows in Damascus. Furthermore, even some dry parts of the region have significant water resources flowing through them, originating in wetter climes. Egypt's southern city of Aswan, for instance, only receives 1mm of rainfall a year, but sits on the banks of the Nile, the longest river in the world. Depictions of the Middle East as water scarce, therefore, must be nuanced by an appreciation of the region's varied geographies.

As for the population part of the narrative, the population growth rate across the Middle East and North Africa is indeed high. At 1.7 percent a year, it is well above the world average of 1.3 percent. Despite slowing growth rates in recent years, the region's population is projected to more than double in size over the first half of the twenty-first century. But here, too, regional generalizations gloss over important distinctions. The particularly high growth rates in some countries—Iraq, Bahrain and Palestine—are not matched in all countries: Lebanon's population is actually projected to shrink over the coming decade. There are important differences within countries as well. Populations in urban areas are projected to grow more rapidly than in rural. Migration and forced displacement also shape population distributions. Most of the Gulf countries

Wadi Rum, Jordan WIKIMEDIA COMMONS\JOHN D'ORAZIO

The Rif Mountains, Morocco WIKIMEDIA COMMONS\GuHKS



CHRISTOPHER KRAUSE

host migrant populations that outnumber their residents. Lebanon and Jordan house significant refugee populations, with the highest and second highest shares of refugees per capita in the world.

Complexities do not make for compelling headlines, though. The broad characterization of the region as water scarce and people rich, on the other hand, tells a simple and powerful story. It is a story that is reinforced by a commonly used indicator, the Falkenmark Water Stress Index. This easily calculable figure is a ratio of the total renewable freshwater resources available in a country to the number of people. If the index is less than 1,000 cubic meters per capita per year, it denotes a situation of water scarcity; if it is less than 500 cubic meters per capita per year, it indicates conditions of absolute water scarcity. According to this indicator, the region does not look good. Most of the countries are facing either scarcity or absolute scarcity.

But what do such figures reveal about the day-to-day experience of living in the Middle East and North Africa? Do they mean that across the region people are struggling to find water to drink, wash and cook? Is water scarcity a daily challenge for everyone living in these arid lands? No. For despite their recurrent citation, these figures obscure a crucial point: Water scarcity is not so much about how much water there is and more about what it is being used for.

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MORE PEOPLE, MORE SCARCITY?

The New York Times published an online interactive feature about the Nile River on February 9, 2020 titled, "For Thousands of Years, Egypt Controlled the Nile." It began with a stunning set of full-page images, each overlain with a simple line of text. The first was a view of the river from space, accompanied by the statement, "Without the Nile, there is no Egypt." The next was a close-up of the river channel backed by sand, with the note that "Egyptians have been masters of the river for thousands of years." The third was an image of a crowd of people sitting at an outdoor café with an ominous message: "But the Nile has never been under such strain. Pollution, climate change and Egypt's soaring population are taking an immense toll." While the article went on to discuss the multiple challenges that Egypt's water managers face, including the dam that

Water Availability in the Middle East and North Africa

	WATER AVAILABILITY (cubic meters/person/year)	FALKENMARK CLASSIFICATION
Algeria	282	Absolute water scarcity
Bahrain	78	Absolute water scarcity
Egypt	589	Absolute water scarcity
Iran	1688	Water stress
Iraq	2348	-
Israel	214	Absolute water scarcity
Jordan	97	Absolute water scarcity
Kuwait	5	Absolute water scarcity
Lebanon	740	Absolute water scarcity
Libya	110	Absolute water scarcity
Morocco	811	Water scarcity
Oman	302	Absolute water scarcity
Palestine	170	Absolute water scarcity
Qatar	22	Absolute water scarcity
Saudi Arabia	73	Absolute water scarcity
Syria	920	Water scarcity
Tunisia	400	Absolute water scarcity
Turkey	2621	-
United Arab Emirates	16	Absolute water scarcity
Yemen	74	Absolute water scarcity

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Ethiopia is building across the Nile's upper reaches, the opening placed population at the heart of the issue. The Egyptian people, not just growing but "soaring" in numbers, are those taking an "immense toll" on this valuable resource.

This is an archetypal Malthusian narrative. Eighteenth century scholar Thomas Malthus proposed that the combination of a limited resource base, only growing at an arithmetic rate, and an expanding population, growing at a geometric rate, would inevitably lead to a point where the system's capacity to support that population was exceeded and crisis would result. This notion, so simplistic and yet so enduring, undergirds much of the writing about water in the Middle East.

But what exactly is the relationship between population size and water use? A larger population means more people drinking, cleaning their homes and bodies, washing clothes and cooking. These daily activities do not, however, require all that much water relative to other water uses. The World Health Organization estimates that an individual needs at least 50 liters a day to live a healthy life, which amounts to less than 20 cubic meters over the course of a year. While domestic consumption may exceed this in higher income countries—in the United States, for instance, the average daily water use is around 400 liters—an annual allocation of 20 cubic meters per capita is sufficient to cover consumption and basic hygiene needs. Water availability in most countries in the Middle East and North Africa

A boy collects water from a faucet in 2015 amid an acute water shortage of clean drinking water in Sanaa, Yemen REUTERS\MOHAMED AL-SAYAGHI

far exceeds this threshold. This does not mean that everyone has abundant clean water in their homes. In cities like Amman and Beirut, many neighborhoods only receive running water for a few hours a day; in war-torn Yemen, millions lack access to clean water. But the lack experienced by some is more due to the inadequacy of the infrastructures for delivering potable water and removing wastewater than the insufficiency of the resource per se.

The threshold for absolute water scarcity, 500 cubic meters per capita, is considerably higher than the amount required for personal use because it also takes into consideration the water needed to grow food and support a nation's industry. Agriculture consumes the greatest amount of water by far, globally. This pattern is particularly pronounced in the Middle East, where low rainfall across much of the region makes irrigation a necessity for cultivation. Agriculture uses 85 percent of the region's water. Governments across the Middle East and North Africa have spent huge amounts of money investing in water infrastructure to meet this need. Libya's Great Manmade River project, for instance, was designed to transfer water pumped from a fossil aquifer deep below the desert in southern Libya, through thousands of kilometers of pipeline to the north, so as to supply cities, but also, tens of thousands of hectares of agricultural land. Israel's National Water Carrier is a series of pipelines, tunnels and canals that diverts water from the Sea of Galilee in the north to the Negev Desert in the south, where 80 percent of the water is used for agriculture.

Given that the agricultural sector uses the most water, what then is the link between water use and population size? A larger population means more people eating food. But does this mean more water used for agriculture? Not necessarily. First, producing more food does not always require more water. There are techniques of applying water to the soil that are less water intensive, allowing for what water specialists term "more crop per drop." Second, a larger population does not have to be fed by crops grown within that country. Almost all countries rely on imports for at least some of their food needs. Many Middle Eastern countries, for example, import large quantities of grain for the production of their staple food, bread. Some water management specialists argue that these food imports can be seen as a source of "virtual water." The fact that some states choose not to rely on imports and instead

tap into their water resources to grow their food, is more about politics than population. The reason why Saudi Arabia long subsidized wheat production in the desert with water drawn from fossil aquifers, for instance, was not because it needed to produce more food for a growing population. Instead, this policy was about the government's interest in becoming more self-sufficient so as to decrease its reliance on other countries and the associated vulnerabilities. Third, not all of what farmers are growing is food, as Egypt's long history of cotton cultivation illustrates. Of the food that they are growing, not all is destined for local populations. Jordan exports strawberries to Britain and Tunisia exports citrus fruits to France. Hence there is no direct correlation between population size and agricultural water use. Narratives of population-driven water crises should always be approached with caution.

This is not to say that population has nothing to do with water scarcity. Take, for example, a city like Cairo, which has grown from 2.5 million people in 1950 to a greater metropolitan area with 20.5 million people today. Bringing together that many people in a particular site places a great strain on water resources and service provision, and the city's water infrastructure has been unable to keep pace.

Virtual Water

Virtual water is a concept that has become prominent in discussions of water in the Middle East. The concept refers to the volume of water needed to produce a particular quantity of agricultural commodity. A kilogram of grain, for instance, contains between 1,000 and 2,000 liters of virtual water. Advocates of the concept argue that virtual water can be used as a mechanism for addressing scarcity. By importing virtual water—or more precisely, by importing the agricultural product in which that water is virtually embedded—a country can save the water it would otherwise use to produce that commodity for other purposes. Yet despite the widespread attention it has garnered, this concept has been subject to significant academic critique. A number of scholars have challenged the reductionist nature of the concept of virtual water and its inability to capture the multiple political, economic and environmental factors that shape agricultural production and trade decisions.

Center-pivot irrigated fields in Wadi al-Sirhan, Saudi Arabia NASA EARTH OBSERVATORY

Many lower income residents, or people living in informal settlements, lack access to sufficient drinking water and sanitation. Populations in motion, too, can generate challenges for water managers. Refugee camps, for instance, which are amalgamations of people in spaces that were not necessarily designed to support those numbers, often struggle to provide enough water for their displaced population's day-to-day uses.

But the key point is that who is using the available water resources and what they are using it for are just as important as how many people are using it. While placing the blame on resource limits and population growth may be politically convenient, absolving authorities of responsibility in creating the water crisis, it erases crucial questions about how states manage and distribute those resources.

CHANGING CLIMATES

Population is not the only changing variable. The available water resources of the Middle East and North Africa are also shifting due to anthropogenic climate change, which is altering temperature and precipitation patterns around the world. In the case of the Middle East, climate change raises three particular areas of concern. The first is rising temperatures. Climate models are consistent in their projections that temperatures across the region are increasing and will continue to do so in coming decades. Higher temperatures mean higher evapotranspiration rates —plants, in other words, will drink more water—and larger losses from open surfaces like reservoirs. Demand from the most water intensive sector, agriculture, will increase.

Second, precipitation patterns are changing. While there is more uncertainty here, due to the difficulties of modeling precipitation dynamics, studies suggest that the variability and uncertainty in rainfall timing and intensity is increasing. The region is likely to experience more extreme droughts as well as heavier downpours and increased risk of flooding. The drought that hit northeastern Syria in 2007–2009, for example, was the most severe on record. Some small areas may see increases in precipitation, but much of the region will probably see a reduction in precipitation over coming decades. The supply of water, therefore, will most likely decrease.

Third, the rise in sea level poses a risk of coastal flooding in deltas, like that of the Shatt al-Arab, on the border of Iraq and Iran, and the Nile Delta as well as other low-lying areas along the Mediterranean coastline. Sea level rise can also lead to the intrusion of saltwater into coastal aquifers, rendering them unfit for use. This effect would further reduce the water supply.

Climate change is thus exacerbating existing stresses on the region's water resources. Although water managers are certainly thinking about climate change, it remains a somewhat peripheral concern in public life. Efforts to integrate climate change adaptation into water management plans are hampered by more pressing political priorities, including negotiations with neighboring states in cases where water resources cross international borders.

TRANSBOUNDARY WATERS

A number of countries in the Middle East and North Africa rely on transboundary water resources. The high degree of reliance is evident in an indicator known as the dependency ratio, which is the proportion of a nation's freshwater resources—both surface and groundwater—that comes from outside that country. Syria and Iraq depend on the Tigris and Euphrates rivers, which rise in the mountainous region of southeastern Turkey. Egypt sources most of its water from the Nile, a river basin that spans 11 countries. Jordan's two main surface water resources, the Jordan and Yarmouk rivers, are shared with its neighbors. Israel taps into surface and groundwater resources that traverse borders with the West Bank, Lebanon and Syria. Kuwait and Bahrain's groundwater reserves are fed by water flowing laterally underground from Saudi Arabia.

This dependence on shared water resources adds complexity to water allocation decisions. Countries have different and competing interests. Relations of power are uneven between those who control the headwaters and

Proportion of a Country's Water Resources that Come from Outside its Borders

	DEPENDENCY RATIO (%)
Bahrain	97
Egypt	98
Iraq	61
Israel	58
Jordan	27
Kuwait	100
Syria	72
Algeria, Iran, Lebanon, Libya, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Tunisia, Turkey, UAE, Yemen	<10

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those who are downstream, as well as between long-term users and those who seek to expand their use. Efforts to tap into shared resources can create tensions with other nations, as in 1990 when Turkey stopped the flow of the Euphrates River for a month to fill the reservoir behind the Ataturk Dam, cutting off the supply to Syria and Iraq. Tensions are also high in the ongoing conflict over Ethiopia's new dam on the Nile. In the case of shared aquifers, the added uncertainties surrounding groundwater volumes and flows compound the challenges.

The combination of limited and shared resources has led to talk in policy circles and the media about the potential for water to be a source of conflict in the region. Commentators sometimes cite the 1967 Arab-Israeli War as an example of water playing into a dispute, or the Nile as a case where tensions could lead to armed conflict. But despite the dramatic appeal of the idea of a water war, most scholars agree that the concept is misleading. Wars typically have much more complicated origins than a single causal factor, like water. Intrastate disputes over water may be more significant than interstate conflicts. Moreover, a shared resource does not necessarily have to be a source of tension; it can be a source of cooperation.

POLICY APPROACHES

Policies for dealing with water scarcity can be clustered in two broad categories: supply-oriented policies, which seek to increase the amount of water that is available for

Conflict in the Nile Basin

The Nile Basin is shared by 11 countries. Stemming from two tributaries—the Blue Nile and the White Nile—the river flows northwards from its origins in the moist East African Highlands to its final stretch through the desert of northern Sudan and Egypt. A treaty signed between Egypt and Sudan in 1959, the Nile Waters Agreement, allocates 55.5 billion cubic meters of water to Egypt and 18.5 to Sudan. Efforts since the 1990s to develop a more comprehensive basin-wide treaty, the Cooperative Framework Agreement, have floundered on the entrenched rift between downstream countries, which maintain their rights based on the principle of historical appropriation, and upstream countries, which call for rights based on equitable utilization. In recent years, tensions have come to a head over Ethiopia's construction of the Grand Renaissance Dam across the Blue Nile. Egypt and Sudan are concerned about how Ethiopia will fill its reservoir once the dam is complete—the quicker it seeks to do so, the more water it will have to hold back. They are also anxious about what the dam will be used for: If it is used for irrigation as well as hydropower, it could have a major impact on those downstream. Since attempts to find resolution on these points have stalled, much uncertainty remains as work on the dam comes to completion in late 2020.

Desalination plant, Oman

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Center-pivot sprinkler irrigation, Egypt

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use and polices that address demand, aiming to reduce the pressure on those resources. Countries in the more arid parts of the Middle East have championed technologies for producing more water. The Gulf states and Israel, for instance, have been leaders in desalination. In these countries, desalinated water now meets the majority of domestic water needs. Producing drinkable water from seawater, however, is expensive, costing between $0.5 and $1.50 per cubic meter. It is also energy intensive, raising questions about sustainability, and produces significant amounts of saline brine that can negatively impact local coastal ecosystems. Although initiatives are underway to develop solar-powered desalination, these projects are still in their infancy.

Wastewater is another source that can be tapped for reuse—either that produced in homes and industries, or water that drained away from fields. In many countries of the region, farmers reuse agricultural drainage water. If municipal and industrial waste is properly treated, it too can be reused. Some countries, like Israel and Jordan, have included wastewater reuse as part of their national water strategies. But this resource has been relatively underdeveloped in the region, in part because of taboos surrounding the use of wastewater and limited capacities for the kind of high-level treatment that it requires. At the same time, a certain amount of de facto reuse takes place as sewage passes untreated back into rivers in the absence of adequate treatment facilities. Indeed, water quality is a growing concern. Many of the region's water bodies are contaminated with sewage, agricultural chemicals and industrial waste, leading to calls for better monitoring and treatment.

There are, therefore, ways of creating new water and of making old water new. There are also ways of changing how water is used. Public awareness campaigns urge residents to conserve water, take shorter showers, turn off the faucet when brushing their teeth, not leave the water running when cleaning dishes and avoid washing their cars. These uses are so small relative to agriculture, though, that their impact is limited. Reallocation of water from agriculture to municipal water supplies could increase the amount of water available for domestic use but would come at the expense of the agricultural sector, which in many countries of the region supports a significant proportion of the population. Alternatively, there are ways of reducing the amount of water that agriculture consumes. Modern technologies like sprinklers or drip irrigation deliver water more precisely to the crop than the traditional method of

flooding a field, allowing farmers to apply less water in total. These technologies are costly, however, and often only affordable to larger landowners unless there is state support. Choosing a crop that is less water intensive—not planting rice, for example—can also be a way of reducing use.

As a way to incentivize such changes in practice, experts have advised authorities to raise the price of water. In most countries of the region, water is priced significantly below its cost of delivery. In some cases, it is free. Egyptian farmers, for instance, do not pay for the water they use on their fields (although they do pay other irrigation-related costs, such as energy for pumps). If they had to pay for water, economists argue, they would not use so much.

While these measures can be effective at reducing water consumption and easing scarcity, they impose costs and can increase rural poverty without other forms of social protection and support for small farmers. They also risk ignoring the larger contextual factors that shape water use in a home, factory or farm. Policies that seek to mandate a technology, price or behavioral change for the sake of saving water, without recognizing the priorities and perspectives of those who use this water on a daily basis, are unlikely to be successful.

CONCLUSION

Water is a complex resource to manage: It crosses international borders, shifts over time due to climate change and is vulnerable both to depletion and degradation. The resource brings together multiple scales of action, from individuals using water in their homes and fields to governments setting water policies and nations negotiating transboundary water treaties. The management of water presents challenges and no easy answers. Instead of reiterating the simplistic argument that the Middle East faces a water crisis due to its arid environment and growing population, what is needed is more attention to furthering understanding of these complexities.

The Middle East does not have abundant water resources; with climate change, this position is only likely to get more acute. But the challenge of water scarcity and the experience of many within the region who struggle to find sufficient, clean water for their everyday needs and livelihoods is as much about economic priorities, social inequalities and political relations as it is a function of the region's geography.

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