Cambridge University Press
978-1-107-04229-2 - Arab Water Security: Threats and Opportunities in the Gulf States
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Excerpt
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Rethinking water and food security in the Arab Gulf states

1.1 Introduction

A scientific journal reported the discovery of seven-million-year-old footprints of elephants, the world's oldest elephant tracks, in the United Arab Emirates (UAE). Paleontologists say the area had much more water, vegetation, and animal life, and its biodiversity resembled what was present in wet parts of Africa and Europe. "The region then was home to a great diversity of animals, including elephants, hippopotamuses, antelopes, giraffes, pigs, monkeys, rodents, small and large carnivores, ostriches, turtles, crocodiles, and fish. These were sustained by a very large river flowing slowly through the area, along which flourished vegetation, including large trees. The animals resembled those from Africa during the same time, though there are also similarities with Asian and European species of that period" (Livescience.com, 2012). The image of a tropical paradise teeming with biotic life is today a polar opposite of what it used to be.

Social stability and economic prosperity rest on regular access to sufficient amounts of potable water. Many areas of the world may have hit "peak water," which explains the growing talk about a water crisis, and why this resource, long taken for granted, is now being called the "new oil" or "blue gold." Throughout history, humans have always been well tuned to nature's rhythms that helped them harness and secure the resources they needed for their survival. They devised new ways for identifying water sources, and for harvesting, transporting, and storing water so to meet their then-simple and basic needs. How will technological advancements affect water security of future generations?

Water security is a complex, multi-dimensional concept. Water insecurity is a relative concept because, at one level, it is an imbalance between water "supply" and "demand" and is affected by spatial, temporal, and economic conditions (Jägerskog *et al*., 2014; Swain, 2012). It is also a dynamic process because it is aggravated by higher human demands, varying supplies, degraded quality of the resource, and by poor governance and inadequate policy response. A recent report by the World Economic Forum (2014) ranked the water crisis as the third most important challenge facing the world. This measure by prominent political and economic leaders from around the world helps focus the attention of governments, businesses, and civil societies on this issue that has been rising in importance. Water security is affected by physical availability and technological ability to produce potable water, and by a government's ability to develop institutions and build the infrastructure necessary to ensure a reliable supply of water.

People and governments increasingly view water as a resource of strategic importance, one that affects human and national security. Fearing an interruption of the supply of critical resources appears to be a common human concern that is unrelated to geography or culture. A recent survey on "British attitudes towards the UK's international priorities" revealed that for most people (53 percent) in the country the biggest future threats to "the British way of life" were terrorism, followed by interruptions to energy supply (37 percent), and "long-term scarcity of essential natural resources, such as water, food and land" (30 percent). Climate change (18 percent) was the fourth and final item on the list of apprehensions (Chatham House, 2011). In another poll, most (48 percent) opinion leaders and decision makers in Britain said that the main focus of their country's foreign policy should be to ensure "the continued supply of vital resources, such as oil, gas, food and water [tied with terrorism]" (Evans 2011). The British fear appears irrational when you consider that the average annual precipitation for the United Kingdom is 1,222 mm (World Bank Data, n.d.). On the other hand, the Gulf states have an average annual precipitation that is well under 125 mm (World Bank Data, n.d.), are void of perennial rivers, and, for the last few decades, have experienced much higher levels of economic and population growth than many countries, including Britain. This, along with their rapidly improving quality of life, have resulted in an astronomical rise in their total and per capita water consumption. As devoid as they are of water, their significant endowments in hydrocarbon wealth has made it possible for them to overcome their physical scarcity of water and food.

The Arab world, from Iraq to Egypt and all the way to Morocco, is one of the most arid regions on the planet. Within this large cultural region is the geopolitical sub-region known as the Gulf Cooperation Council (GCC), which includes Saudi Arabia, UAE, Kuwait, Qatar, Bahrain, and Oman. Although Yemen and Iraq are non-members, the turmoil and wars they have long experienced pose serious security challenges to the GCC. It has been trying to contain the socio-political spill-over effects of these and other wars on their countries. Since 1980, Iraq and Yemen have experienced wars and violent insurgencies. Iraq, for example, invaded Iran in 1980, triggering an eight-year war, and then invaded Kuwait in 1990.

Kuwait's desalination plants were thought to be within the range of Iraqi and Iranian missile placements and therefore "easily targetable" (Cordesman, 1997, p. 58). The United States' 2003 war on Iraq led to the collapse of the nation state and its institutions, which in turn fueled waves of insurgency and terrorism that continued well into 2014. When the once-divided Yemen was united in 1990, many people in the northern and southern parts of the country did not buy into the social and political integration, leaving the country in the throes of perpetual turmoil. High unemployment and political instability drive many Yemenis to seek a better life in the wealthier Gulf states, and some profit from illegal activities such as smuggling people, weapons, and drugs into Saudi Arabia. Finally, Al Qaeda in the Arabian Peninsula is based in southern Yemen.

The natural environment is the original culprit in the hydrological conditions that Arabs contend with. The Arab world is located in a generally arid to very arid region where environmental conditions have gradually worsened for the people. The renewable water resources available in 1950 were over 4,000 m^3/capita per year, declined to 1,312 m^3/capita per year in 1995, and slipped to 1,233 m^3/capita per year in 1998; they are projected to reach 547 m^3/capita per year in 2050 (Arab Water Council, 2009). Yemen, one of the most water-deficient countries in the world, has an annual per capita water availability of only 125 m^3, compared to the global average of 2,500 m^3 (WWAP, 2012). The freshwater that is available for the people of Yemen or for the GCC countries is significantly lower than the global average, which underscores the severity of the situation in this region. Scholars classify a country as experiencing "water stress" when its annual renewable water supplies fall below 1,700 m^3 per person, "water scarcity" when they reach 1,000 m^3 per person, and as having "absolute scarcity" when they dip below 500 m^3 per person (WWAP, 2012). All of the Gulf states suffer from an acute case of absolute water scarcity.

Over the past five decades, these countries have experienced a dramatic increase in population and in the quality of life that strained their natural water supplies so much that they looked for alternative sources that would supplement their aquifers; they chose to desalinate seawater to meet their domestic freshwater needs. Furthermore, since the 1960s, the Arab Gulf states have experienced dramatic increases in population sizes due to high natural growth rates and, more importantly, due to the very high influx of foreign workers. This, together with the fast pace of modernization and urbanization have rapidly inflated the size of primate cities like Dubai (1.9 million), Riyadh (5.5 million), Jeddah (3.6 million), and Kuwait city (2.4 million) (CIA, 2011). Current research predicts that the availability of renewable freshwater resources will continue to decrease with changes in precipitation and recharge rates of groundwater resources. By 2050, renewable water resources in many Middle Eastern countries – including those in the GCC – will decrease between 25 and 40 percent (FutureWater, 2011).

Among the GCC countries, Saudi Arabia and the UAE have the largest population sizes, and therefore experienced the largest net increases. Yet, even though Bahrain only has 1.3 million people (2013), the country's population has increased by over 700 percent since 1960 (Table 1.1).

With the significant increase in population and the demand for water, the natural water resources of the Arabian peninsula have been stretched and are not enough to support the population. For all Gulf countries, the total renewable water resources per capita have decreased dramatically (Table 1.2). Since the 1960s, the renewable water resources per capita in Oman, Saudi Arabia, Bahrain, and Kuwait have decreased by 82, 84, 86, and 89 percent, respectively. The biggest decreases were in Qatar and the UAE where population growth skyrocketed and their renewable water resources per capita have fallen by 97 percent and over 98 percent, respectively.

Table 1.1 *Population size in 1960 and 2013, and the percent increase*

Country	Total population, 1960	Total population, 2013	Percentage population increase, 1960–2013
Bahrain	162,501	1,332,171	719.8
Kuwait	261,994	3,368,572	1,185.7
Oman	551,737	3,632,444	558.4
Qatar	47,316	2,168,673	4,483.8
Saudi Arabia	4,072,110	28,828,870	608.0
UAE	89,608	9,346,129	10,330.0
Yemen*	5,099,785	24,407,381	378.6
Tunisia*	4,220,701	10,886,500	157.9
Hungary*	9,983,967	9,897,247	−0.8
Canada*	17,909,009	35,158,304	96.0

* These countries are intended to serve as a rough reference point.
Source: Statistics calculated from World Bank Databank, databank.worldbank.org.

Table 1.2 *Total renewable water resources per capita (m^3/inhabitant/year)*

	1962	1992	2012
Bahrain	670.5	221.8	88.01
Kuwait	59.7	10.6	6.15
Oman	2,418	863.1	422.50
Qatar	1,036	137.1	28.28
Saudi Arabia	552.2	165.2	84.84
UAE	1,376	99.0	16.29
Yemen	398	201.7	88.04

Source: AQUASTAT, United Nations, http://www.fao.org/nr/water/aquastat/dbases/index.stm.

Table 1.3 *Average annual precipitation levels in the Gulf states and Yemen*

Country	Bahrain	Kuwait	Oman	Qatar	Saudi Arabia	UAE	Yemen
Precipitation (mm/yr)	83	121	125	74	59	78	167

Source: AQUASTAT, United Nations, www.fao.org/nr/water/aquastat/.

The Arab Gulf states share largely similar climatic conditions but there are some important variations between them. Except for a few areas, most of the peninsula is either classified as desert or semiarid mountains. Although the Oman Mountains and Asir Mountains in south and western parts of the Arabian Peninsula enjoy higher rates of precipitation and runoff, there are no perennial rivers or lakes in any of the GCC countries. Rain generally occurs in the winter months, is unpredictable, and often results in flash flooding, temporarily filling wadis. Topographically, much of the region is flat. Combined with high evaporation rates, the topography makes it difficult to harvest rainwater and little of it recharges groundwater before it is evaporated (Al-Rashed and Sherif, 2000). Average annual rainfall (Table 1.3) can be misleading because of the intense evaporation and the significant variation in precipitation between the hyper-arid deserts and the mountainous areas which receive much higher levels of rainfall.

The sporadic and meager surface water resources of the GCC states are minor compared to the large but diminishing fresh groundwater resources throughout the region. Alluvial groundwater aquifers tend to be shallow, recharged by rainwater, and their water of better quality. Non-renewable deep aquifers are not fed by infiltrating rainwater. Groundwater resources in the deep aquifers are estimated at 2,330 billion cubic meters and over 30 percent of the groundwater reserves are located in the Wasia-Biyadh aquifer (one of the largest in Saudi Arabia). Depending on the geological composition, the quality of water varies significantly from one aquifer to another. Overuse due to irrigation has affected the quality and productivity of aquifers. In areas along the coast of GCC countries, saltwater intrusion into freshwater aquifers is a problem (Al-Rashed and Sherif, 2000; Al-Hajri and Al-Misned, 1994).

The smallest of the countries, Bahrain, has an arid to hyper-arid environment with high temperatures, erratic rainfall, and high evaporation rates. Rain only supports the most drought-resistant vegetation. The principle source of water is from the Dammam Aquifer, only a small part of the larger Eastern Arabian Aquifer. However, the aquifer has suffered severe degradation and salinization from multiple sources: (1) brackish-water up-flow from underlying water zones below the aquifer, (2) seawater intrusion, (3) intrusion from saline aquifers, and

(4) return flow from irrigation (FAO, 2008; Musayab, 1988). Over-exploitation of groundwater has also damaged what few wetlands existed and has resulted in the drying of all natural springs (UNDP, 2013).

Most of the soil in the Gulf states does not retain moisture and is made up of many "hard pans," referred to by locals as "gutch," which prevent water from infiltrating into aquifers. This, high evaporation rates, and the over-drafting of aquifers for irrigation have been depleting these mostly non-renewable resources and degrading their quality. The meager rainfall is unpredictable and insufficient to support rain-fed irrigation, but it is the main source of recharge for the few renewable aquifers in the Gulf. Freshwater aquifers in the Gulf states usually lie above saline groundwater and their over-use has caused saline water to up-flow into the aquifer (Lloyd *et al*., 1987). This mis-management has caused a lowering of the water table and deeper, brackish water to up-flow into freshwater sources. Many of the aquifers are composed from limestone, which has led to severe seawater intrusion and increased salinity of groundwater (AQUASTAT, 2009).

There are groundwater resources in the Bajada region. These aquifers contain water from alluvial fans along the base of the Oman and Ras Al Khaymah mountains. Dams have been built in areas where water infiltrates through permeable streambeds, hence replenishing groundwater (Murad *et al*., 2007).

While many of the GCC countries are similar in climate and have few options concerning water resources, both Oman and Saudi Arabia are much more environmentally diverse and have more natural freshwater resources than other Gulf states. Oman, for example, is divided into three regions. The coastal plains consist of vital agricultural areas and are hot and humid throughout the year. In the southernmost reaches, monsoons occur during the summer. Even though there are wadis with intermittent surface runoff, internal groundwater is the main reliable source of renewable freshwater. There are several important aquifers in the northern and southern areas and the soil easily allows precipitation to infiltrate into the groundwater. Some of these aquifers are a part of the larger system that extends throughout the peninsula. In addition to these, most other sources of groundwater are brackish to saline. There are also large amounts of freshwater reserves in aquifers that were filled a long time ago when climate conditions were different. These non-renewable resources have a very low recharge rate and have been designated by the government as a reserve for future use (World Bank, 1988), and are being increasingly treated as reserve for future use

Saudi Arabia also has significant water resources and varied climates. The Western Mountains, or "Arab Shield," consists of high peaks, deep valleys, and enjoys the heaviest rainfall in the region. East of these mountains are the central hills and further east of that is a sandy, hot, desert region. The government of Saudi

Arabia has constructed dams in different parts of the country to trap water from the short-lived flash floods, which is used for groundwater recharge, and irrigation. The quality of groundwater varies from area to area but most of it is classified as brackish (Gutub *et al*., 2013).

Climate change exacerbates prevailing hydrological stress. A study commissioned by the World Bank reviewed the results of nine global climate-change models and reported that the gross recharge between 2010 and 2050 is expected to drop sharply in "almost all" the Middle East and North American (MENA) countries, where the largest declines for that period are expected in Oman, UAE, and Saudi Arabia. The models reveal that the largest decreases in internally and externally renewable water resources in the Gulf will be in Oman (–46 percent) and Saudi Arabia (–36 percent) (Immerzeel *et al*., 2011, p. 57).

Freshwater, already a scarce resource, is becoming harder to find due to population pressure, mismanagement, and climate change. Desalinated water is critical to the well-being of people of the Gulf and to the modern economies that they have come to depend on. Enduring sustained water-supply disruptions could have serious ramifications on the social and political stability of a country. Therefore, a better understanding of threats to water supplies would gauge the social resilience of affected countries, provide useful information to the business sector, and deliver respective government agencies an early warning, encouraging them to consider preventative or mitigating measures that would ensure water security for all.

Water security has been a dominant concern in certain transboundary water negotiations (Mekonnen, 2010), and has been adopted by major international aid agencies such as those of the German and American governments (BMZ, 2010; USAID, 2014). It has also been linked to economic growth and human development (Liu *et al*, 2007), and associated with sustainable development (Vörösmarty *et al*., 2010). One of the early definitions of water security was given by the Global Water Partnership (2000), which viewed it as every person having "access to enough safe water at affordable cost to lead a clean, healthy and productive life, while ensuring the environment is protected and enhanced". This ministerial-level meeting at the World Water Forum at The Hague stated that despite the huge diversity of circumstances around the globe, all nations desire a future that includes the goal of water security. The forum had a very broad understanding of this notion: "This means ensuring that freshwater, coastal and related ecosystems are protected and improved; that sustainable development and political stability are promoted, that every person has access to enough safe water at an affordable cost to lead a healthy and productive life and that the vulnerable are protected from the risks of water-related hazards." It then outlined a seven-step roadmap to achieving water security:

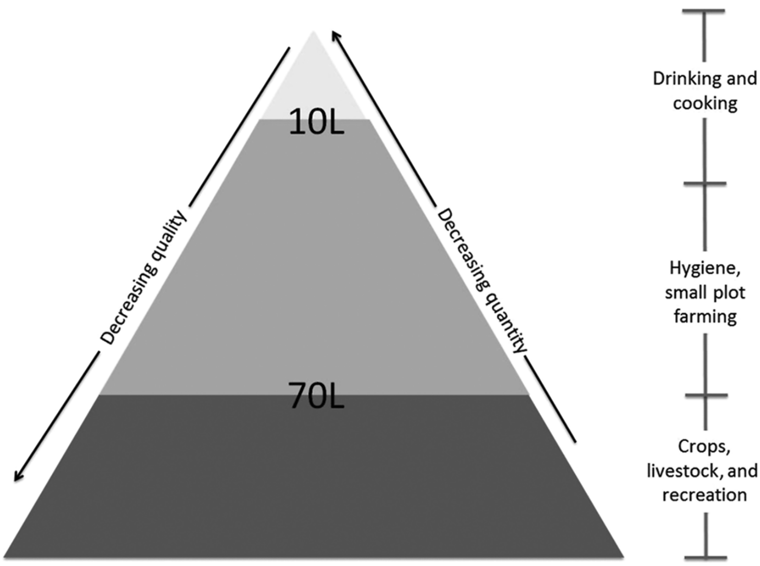

Figure 1.1 Hierarchy of water needs

1. Meeting basic human needs: this would be achieved through access, water quality and quantity, sanitation services which affect quality, and about participatory water management where the people, especially women, are empowered (Figure 1.1).
2. Securing the food supply: this would be achieved through more equitable allocation and efficient use of water, a process that is assumed to benefit the poor and vulnerable in society.
3. Protecting ecosystems: this would be achieved through sustainable water-resources management.
4. Sharing water resources: this would be achieved through cooperative "sustainable river-basin management or other appropriate approaches" at all possible geographic scales, the local, transboundary, or regional, by identifying synergies between different water uses
5. Managing risks: this would be done through protection from all water-related hazards ranging from pollution, to floods and droughts.
6. Valuing water: this would be achieved by gradually moving towards pricing water in a way that reflects the full cost of its provision, while respecting equitable access of the poor and vulnerable in order that they too can meet their basic human needs.
7. Governing water wisely: this would be achieved through the participation of all stakeholders in the management of water resources.

These understandings of water security are centered on people and ecosystems, with some being more explicitly eco-centric. The forum's definition, the most comprehensive of those reviewed, is so broad that makes its noble goals harder to achieve where, for example, people are expected to shed their human-centric view of water. In recent years, Grey and Sadoff (2007, p. 545) crafted the most quoted conceptualization of water security, which is, "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 *et al*. (2013, p. 4) later framed water security in terms of a "tolerable level of water-related risk to society". For Tindall and Campbell (2010, p.1), "water security is the protection of adequate water supplies for food, fiber, industrial, and residential needs". After explaining the notion, the same sentence explains that the goal "requires maximizing water-use efficiency, developing new supplies, and protecting water reserves in the event of scarcity due to natural, [manmade], or technological hazards" (see Figure 1.2).

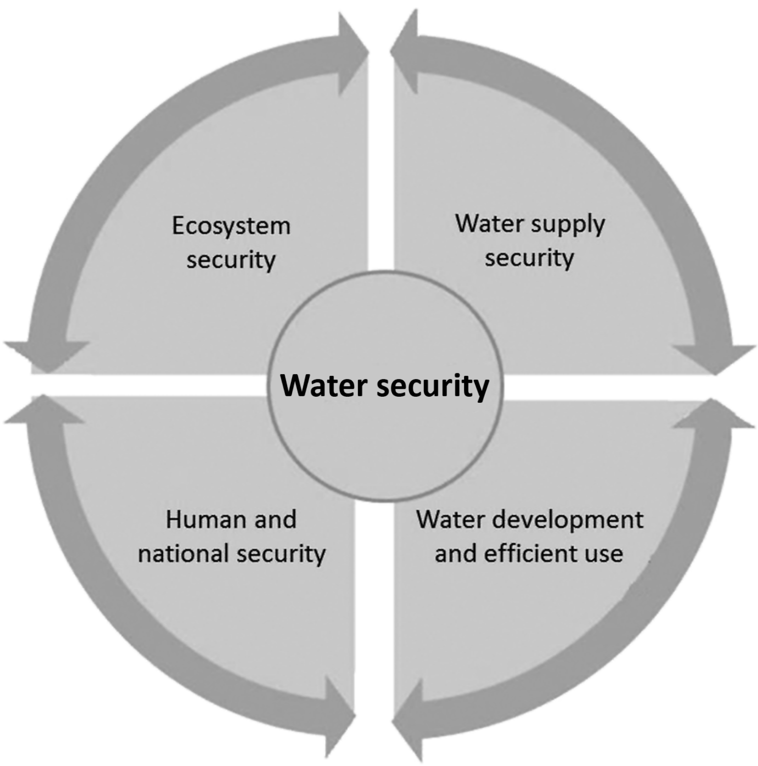

Figure 1.2 Conceptualization of water security

This book investigates the national security implications of the Gulf states' reliance on freshwater produced by desalination plants. This is done by assessing threats to their water and food security, and by suggesting ways to mitigate them. Since the early 1990s countries around the world have recognized that a multitude of national and transnational forces threaten their security and livelihood, and these threats include environmental degradation, disease, and climate change. Hence, the concept of security was expanded beyond traditional military threats against the nation state, and the notions of human and environmental security were developed (Jägerskog *et al*., 2014; Swain, 2012). The Arab Human Development Report (UNDP, 2009, p. 2) defines human security as "the liberation of human beings from those intense, extensive, prolonged and comprehensive threats to which their lives and freedom are vulnerable".

These threats range from political instability in and around the Gulf states to environmental threats to desalination plants on the scale of the 2010 Deepwater Horizon oil spill which caused an environmental disaster in the Gulf of Mexico. Additional threats include major terrorist attacks on water or energy infrastructure disrupting supply for an extended period, or attacks that target skilled guest workers leading to mass emigration. While most of these are low portability scenarios, if any one of them were to occur, it would have catastrophic impacts on political stability of the affected country.

1.2 Water and insecurity

A recent United Nations World Water Development Report (WWAP 2012, p. 10) highlights a well-known aspect of water insecurity, namely that war interrupts water supply. It notes "violent conflict has also destroyed water infrastructure at different times in Beirut, Kuwait and Lebanon, requiring rehabilitation instead of expansion of delivery." Another form of water insecurity was discussed in 2012 by the US Government Intelligence Community Assessment (ICA), which focused on, among other things, the use of water as a weapon of terror. This thoroughly researched assessment (ICA, 2012, p. 3) found that by 2022, "water problems will contribute to instability in states important to US national security interests". Here, one can surmise that this covers the Gulf states. The report had a narrow scope focusing primarily on transboundary watercourses. The classified and declassified portions of the 26-page report did not offer "a comprehensive analysis of the entire global water landscape"; instead it "focused on a finite number of states that are strategically important to the United States and transboundary issues from a selected set of water basins", which are "sufficient to illustrate the intersections between water challenges and US national security" (ICA, 2012). Because the assessment's main focus was on transboundary watercourses, it paid cursory