The Arab Gulf States Institute in Washington

Building bridges of understanding

Water at the Nexus of Gulf Security and Growth Challenges

Mai Mahmoud

The Arab Gulf States Institute in Washington

Building bridges of understanding

October 12, 2016

Water at the Nexus of Gulf Security and Growth Challenges

Mai Mahmoud

Policy Paper

#3

2016

The Arab Gulf States Institute in Washington (AGSIW), established in 2014, is an independent, nonprofit institution dedicated to increasing the understanding and appreciation of the social, economic, and political diversity of the Arab Gulf states. Through expert research, analysis, exchanges, and public discussion, the institute seeks to encourage thoughtful debate and inform decision makers shaping U.S. policy regarding this critical geostrategic region.

Arab Gulf States Institute in Washington
1050 Connecticut Avenue, NW
Suite 1060
Washington, DC 20036

This publication can be downloaded at no cost at www.agsiw.org.

Cover Photo Credit: AP Photo/Jon Gambrell

About the Author

Mai Mahmoud is a freelance researcher. Her research interests include international relations, Middle East studies, political economy, and development economics. She has worked as a research assistant at the Egyptian Foreign Policy Forum, the Middle East Centre of the London School of Economics, and New York University. Mahmoud earned her MSc in economics at the London School of Economics in 2015, and her BSc in banking and finance from the University of London in 2012.

Executive Summary

Gulf Arab states face some of the most severe water shortages in the world. The situation emerges from limited availability of renewable water resources and escalating demands that result from the quick pace of economic development, rapid population growth, changing consumption patterns, and management inefficiencies. Accordingly, sustainable water provision is a persistent challenge facing governments of the Gulf Cooperation Council states as they seek to ensure human security, and maintain social and political stability. Furthermore, threats to water security include the possibility of a cyber, terrorist, or military attack targeting critical infrastructure and water supply networks. Thus, water security is a national security priority for GCC governments.

As a result of the hydroclimatic conditions of the Gulf region, GCC countries tend to rely on desalinated seawater, groundwater resources, and recycled wastewater. Each of these water resources has its limitations and needs to be evaluated in terms of its long-term financial and ecological sustainability. Besides, the interlinkages between the water, energy, and food sectors should be addressed through an integrated management approach.

To tackle water scarcity and enhance economic efficiency, Gulf states have pursued several initiatives such as importing water – either explicitly by delivering water across borders or implicitly by importing water-intensive products. However, the attractiveness of this approach is restricted by geopolitical complexities and national security considerations. Alternatively, GCC states have recently switched to “outsourcing farming” in order to save their limited groundwater resources and maintain food security.

Given the pivotal role of water for the survival of countries and the prosperity of civilizations, this paper presents the opportunities and threats facing Gulf countries in their progress toward sustainable water resource management. It provides a comprehensive analysis that encompasses environmental, economic, and political concerns related to the issue of water security. And it offers recommendations for policy measures for the GCC states to maintain water security and improve sustainability.

Policy Recommendations: Gulf Arab States

- Enhance cooperation and coordination among stakeholders in the management of water, energy, and food sectors. It is crucial to establish a national interministerial council that encompasses a water-energy-food nexus approach in resource management. Bahrain took positive steps in this regard by establishing the High Council for Water Resources in 1982. The council is chaired by the prime minister and works to coordinate water utilization between competing sectors.

- Diversify the mix of energy sources applied in desalination. Renewable and environmentally safe energy sources such as wind and solar energy have strong potentials in the Gulf region, which is located in the world's "sun belt." An exemplary approach in applying solar energy in desalination is the King Abdullah Initiative for Solar Water Desalination, which was launched in 2010. The ultimate goal of the initiative is to enable all seawater desalination in Saudi Arabia to be carried out using solar energy by 2019, at a significantly low cost of $0.40 per cubic meter ($m^3$).[1]

- Increase water tariffs in order to decrease demand. While socially unpopular and politically sensitive, water and electricity subsidies should be gradually shifted to reflect the real economic cost of water provision. A new pricing mechanism – which imposes progressive tariffs on drinking water while demanding water pricing at actual cost for industrial and commercial activities – should ensure that basic human needs for fresh water are met at a low price, while excessive use is priced at a tariff that reflects cost. The new, progressive tariffs introduced by the Emirate of Abu Dhabi in January represent a model for GCC countries in implementing essential subsidy reforms.[2]

- Improve water efficiency in local food production. Given the high rates of water use by the agricultural sector in GCC countries, increased irrigation efficiency coupled with better crop choices could result in more than 70 percent water savings in the region.[3]

- Conduct greater oversight of foreign direct investments in farmland. Gulf states should ensure sufficient levels of transparency in land purchase or leasing agreements to address the ethical and political concerns of different stakeholders.

- Address climate change challenges in a dynamic and science-based approach. Climate change is likely to make the Gulf region more susceptible to extreme hydrological events. Thus, it is vital to rely on projections of possible climate change scenarios and formulate risk management policies at the regional and subregional levels. The Arab Water Council and the GCC Electricity and Water Committee provide suitable platforms for the required cooperation in policy formulation.

1 Waleed Al-Zubari, "Sustainable Water Consumption in Arab Countries," in *Sustainable Consumption for Better Resource Management in Arab Countries* (Beirut: Arab Forum for Environment and Development, 2015), 108-33.

2 See "Abu Dhabi raises water, electricity tariffs," *Gulf News*, January 2, 2016; and "New water and electricity tariffs structure," Regulation & Supervision Bureau, accessed October 5, 2016.

3 United Nations Development Programme, *Water Governance in the Arab Region: Managing Scarcity and Securing the Future* (New York: United Nations Development Programme, November 28, 2013).

Introduction

The Gulf Arab states are located in one of the most arid regions on the planet. Sustainable water provision is a persistent challenge facing governments of the Gulf Cooperation Council states as they seek to ensure human security, and maintain social and political stability. The limited availability of renewable water resources combined with escalating demands stemming from rapid economic development, dramatic population growth, changing consumption patterns, and management inefficiencies has heightened concerns for the GCC states.

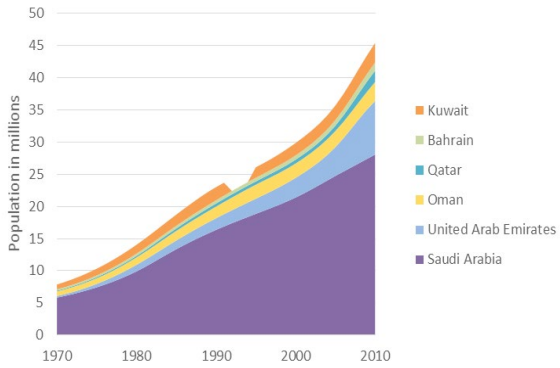
Because of the hydroclimatic conditions of the Gulf region, GCC countries have depended on desalinated seawater, groundwater resources, and recycled wastewater. However, these resources have limitations in terms of their long-term financial and ecological sustainability. Furthermore, considering the interdependences between the water, energy, and food sectors it is advantageous to utilize an integrated management approach.

But in considering water resource management, it is imperative not to neglect the associated political implications. Attempts to remove water and energy subsidies, which represent a significant burden on the fiscal budgets of Gulf states, should be assessed with respect to their socio-political impact. In addition, there is a pressing need to examine the vulnerability of water infrastructure to threats that could arise from regional instabilities or domestic turbulence.

Water Scarcity

The United Nations Development Programme's Arab Human Development Report 2009 indicated that water scarcity is one of the gravest threats to human security in the Arab world, in general, and in the Gulf region in particular.[4] Since the 1970s, GCC states have experienced a dramatic increase in population sizes as result of the high population growth of indigenous people as well as an increase in the number of guest workers over the years. The total population of the GCC states grew from 8 million in 1970 to around 45 million in 2010 (Figure 1). Given the limited availability of water resources in the region, population growth has caused a sharp drop in the average per capita freshwater availability from approximately 600 cubic meters (m^3) per year to 160 m^3 per year over the same period (Figure 2).

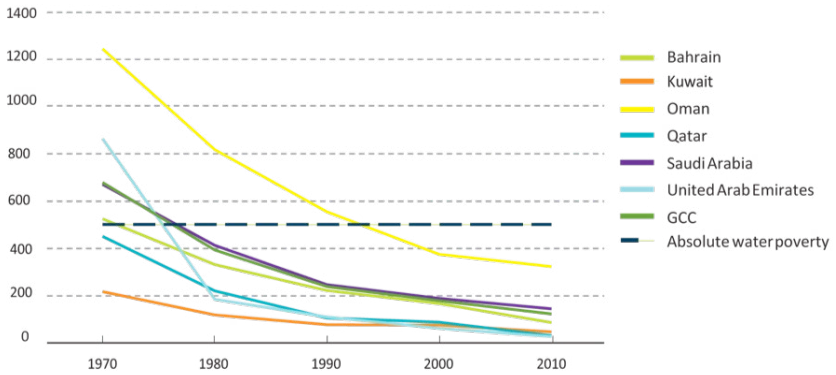
Figure 1: Total Population of GCC Countries (1970 – 2010)



Adapted from World Bank Data 2016

4 United Nations Development Programme, *Arab Human Development Report 2009* (New York: United Nations Development Programme, 2009).

Figure 2: Per Capita Water Availability Trends in the GCC Countries (1970 – 2010)



World Water Assessment Programme, *The United Nations World Water Development Report 4: Managing Water under Uncertainty and Risk* (Paris: World UNESCO, 2012).

According to the World Water Assessment Programme, a country is classified as experiencing "water stress" if its annual renewable water supplies are lower than 1,700 m^3 per person, "water scarcity" if they reach 1,000 m^3 per person, and "absolute scarcity" when they fall below 500 m^3 per person.[5] Thus, the Gulf states have been suffering from absolute water scarcity since the early 1980s, except for Oman, which reached absolute water scarcity by the mid-1990s.

Limitations of Available Water Resources

Countries in the Gulf region face some of the most severe water shortages in the world. There are no perennial rivers or lakes in any of the GCC countries. Rainfall is scarce and irregular with an average of less than 100 millimeters per year.[6] In addition, high evaporation rates and the hydrological effects of climate change are exacerbating current conditions.

Historically, GCC countries have relied on groundwater resources, which are split into two types: renewable, shallow aquifers and nonrenewable, deep aquifers. Shallow aquifers represent the only renewable water source for Gulf states; however, they have limited replenishment rates with an estimated annual recharge of 3.5 billion cubic meters (BCM).[7] Large deep aquifers contain nonrenewable supplies of fossil water with estimated reserves of 2,330 BCM, and over 30 percent of these reserves are located in Saudi Arabia.[8]

5 World Water Assessment Programme, *The United Nations World Water Development Report 4: Managing Water under Uncertainty and Risk* (Paris: World United Nations Educational, Scientific and Cultural Organization, 2012).

6 One millimeter of rainfall is equivalent to one liter of water per square meter. See Omar Saif, Toufic Mezher, and Hassan A. Arafat, "Water Security in the GCC Countries: Challenges and Opportunities," *Journal of Environmental Studies and Sciences* 4, no. 4 (August 26, 2014): 329-46.

7 Waleed K. Al-Zubari, "Water Resource Management Challenges in the GCC Countries: Four Scenarios," in *Exploiting Natural Resources Growth, Instability, and Conflict in the Middle East and Asia*, eds. Richard Cronin and Amit Pandya (The Henry L. Stimson Center, 2009): 3-20.

8 Hussein A. Amery, *Arab Water Security: Threats and Opportunities in the Gulf States* (Cambridge: Cambridge University Press, 2015).

Although Saudi Arabia possesses substantial amounts of nonrenewable groundwater, these aquifers are being rapidly depleted for irrigation purposes. Moreover, overdrafting is deteriorating the quality and productivity of groundwater resources.

As the demand for water increased over time, Gulf states started to depend on nonconventional water resources such as desalinated sea water and reclaimed wastewater. The introduction of desalination technology dates back to 1938 when the first desalination plant was built in Saudi Arabia.[9] The installation of desalination plants started to gain momentum in the mid-1950s and became more significant after the early 1980s as a result of oil-driven economic development. Today, 57 percent of the world's desalination activity takes place in the waters of the Gulf, with more than 30 desalination plants installed in Saudi Arabia alone.[10]

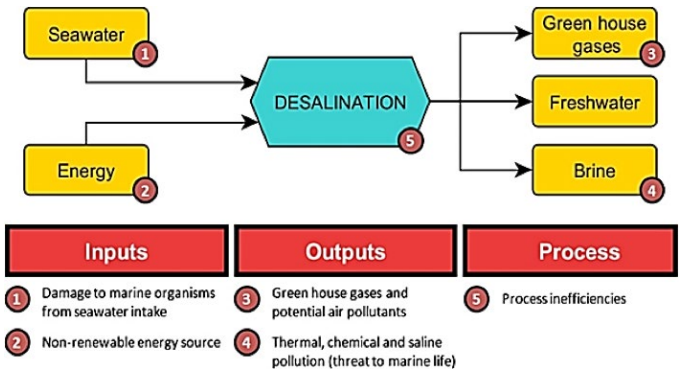
Treated municipal wastewater is also gaining importance in the region. The technology of wastewater recycling was introduced in the Gulf by the early 1980s, with the completion of sewage water treatment facilities and sewage networks in large cities. However, Gulf states have not yet untapped the full potential of wastewater treatment. Reclaimed wastewater does not exceed 12 percent of domestic water supply and is used mainly for irrigating urban gardens, parks, highway landscaping, and fodder crops.

Environmental Sustainability Concerns

Environmental Impact of Desalination

Desalination plants extract the salt found in seawater, either by heating the water and condensing the steam (such as in multiple effect distillation) or by pushing the water through a membrane that filters out the salt (such as in reverse osmosis). In general, there are various environmental concerns associated with desalination facilities. Omar Saif et al. summarize these as input, output, and process concerns (Figure 3).

Figure 3: Box Model of Environmental Impacts Related to Desalination



Omar Saif, Toufic Mezher, and Hassan A. Arafat, "Water Security in the GCC Countries: Challenges and Opportunities," *Journal of Environmental Studies and Sciences* 4, no. 4 (August 26, 2014): 329-46.

9 Hussein A. Amery, "The Geopolitics of Water Scarcity," in *Water and Food Security in the Arabian Gulf* (Emirates Center for Strategic Studies and Research, 2013), 61-80.

10 Omar Saif, Toufic Mezher, and Hassan A. Arafat, "Water Security in the GCC Countries: Challenges and Opportunities," *Journal of Environmental Studies and Sciences* 4, no. 4 (August 26, 2014): 329-46.

Regarding inputs, the intake of seawater for desalination plants disrupts the ecosystem of the living organisms within the vicinity of desalination plants' intake pipes. The threat of intake pipes to the marine environment is highly variable and depends on "the technology employed for seawater intake; how far the intake pipe is from the shore as well whether the intake pipes are open sea or subsurface."[11]

The quality of seawater used in desalination is afflicted by exogenous factors such as oil spills, red tides, and nuclear contamination. For instance, the Regional Organization for the Protection of the Marine Environment estimates that about 1.2 million barrels of oil annually are spilled in the Gulf, where 60 percent of the world's oil exports pass through the Strait of Hormuz.[12] There is also a significant threat of a radioactive spill into the waters of the Gulf. This could occur due to a natural disaster or an act of war with Iran – the only nuclear state that is not a signatory to the Convention on Nuclear Safety.[13] Additionally, several Gulf states, such as Saudi Arabia and the United Arab Emirates, are in the process of implementing ambitious nuclear power programs with significant capacity. The implementation of such programs has to be accompanied with the suitable safety culture and skills for managing radioactive waste to avoid catastrophic damage to the environment, particularly the waters of the Gulf.

Desalination plants are also energy intensive, depend mainly on fossil fuels, and have limited operation lives of 15 to 25 years. The use of fossil fuel as an energy supply is problematic in terms of greenhouse gas emissions as well as the longevity of the energy source. In Saudi Arabia, for example, up to 1.5 million barrels of oil are burned daily to fuel desalination plants.[14] This energy consumption pattern is in sharp contrast with the GCC countries' commitment to meet the global sustainable development goals, particularly number seven, which calls for enhancing energy efficiency. Further, the outcomes of the 2015 global climate summit in Paris suggested that GCC states shift toward renewable energy for a low carbon economy. In fact, the contribution of desalination plants to carbon dioxide emissions in the region is hazardous; desalination plants in Abu Dhabi alone release about 4 to 9 million metric tons of carbon dioxide annually.[15] This is compared to a total of approximately 200 million tons annually of greenhouse gas emissions in the UAE, where water and electricity production account for 33 percent of emissions.[16]

...desalination plants in Abu Dhabi alone release about 4 to 9 million metric tons of carbon dioxide annually.

11 Omar Saif, Toufic Mezher, and Hassan A. Arafat, "Water Security in the GCC Countries: Challenges and Opportunities," *Journal of Environmental Studies and Sciences* 4, no. 4 (August 26, 2014): 329-46.

12 Waleed K. Al-Zubari, "Water Resource Management Challenges in the GCC Countries: Four Scenarios," in *Exploiting Natural Resources Growth, Instability, and Conflict in the Middle East and Asia*, eds. Richard Cronin and Amit Pandya (The Henry L. Stimson Center, 2009): 3-20. See also Walid Elshorbagy, "Overview of marine pollution in the Arabian Gulf with emphasis on pollutant transport modeling," (keynote address, ArabianCoast, November 2005).

13 Ali Vaez and Karim Sadjadpour, "Iran's Nuclear Odyssey: Costs and Risks," *Carnegie Endowment for International Peace, April 2, 2013.*

14 Kieran Cooke, "Turmoil in Saudi water sector as country runs dry," *Middle East Eye,* July 10, 2016.

15 Omar Saif, Toufic Mezher, and Hassan A. Arafat, "Water Security in the GCC Countries: Challenges and Opportunities," *Journal of Environmental Studies and Sciences* 4, no. 4 (August 26, 2014): 329-46.

16 Vesela Todorova, "UAE released 200m tonnes of greenhouse gases in 2013," *The National*, January 21, 2015.

Finally, a major environmental concern of desalination is the discharge of large amounts of salt brine into sea water. The discharged brine is usually a mixture of saline concentrate along with thermal and chemically added pollutants. This has resulted in increasing the salinity and temperature of the Gulf water, which, in turn, raises the cost of future desalination and threatens the livelihood of aquatic species. Gulf countries flush an estimated 24 tons of chlorine, 65 tons of pipe-cleaning anti-scaling agents, and about 300 kilograms of copper into the waters of the Gulf daily.[17] Given the semienclosed nature of the Gulf, the impact of high desalination rates presents a unique case that necessitates collective action by all stakeholders.

Degradation of Groundwater

Overextraction of groundwater means that freshwater aquifers are being used at a rate that outpaces their average replenishment. Most GCC states extract groundwater at a rate that is roughly three times the recharge rate of their renewable groundwater resources, with the exception of the UAE where the ratio is considerably higher.[18] The problem with groundwater overextraction is not only the depletion of a much-needed water resource, but also the degradation of groundwater quality due to seawater intrusion into aquifers.

Ambitious food self-sufficiency programs are often blamed for the overexploitation of groundwater resources, since these policies have not been subject to essential assessments in terms of their impact on the sustainability of groundwater resources. Saudi Arabia, for instance, has recently abandoned its 30-year program of food self-sufficiency after depleting four-fifths of its fossil water.[19] The country extracts an estimated 14 million cubic meters (MCM) of groundwater yearly, with agriculture accounting for more than 80 percent of water usage.[20]

Water-Energy-Food Nexus

The water scarcity challenge in Gulf states is compounded by its multiple nexuses, particularly the "water-energy-food nexus." Afreen Siddiqi and Laura Diaz Anadon explain that energy is required in all segments of the water value chain: "energy is needed for abstraction (e.g., for pumping surface or ground water), purification (e.g., for desalination and wastewater treatment for reuse), distribution (e.g., to transport water over long distance pipelines and in urban supply networks), utilization (e.g., to heat water in industrial applications and for domestic use, and for irrigation applications), and disposal (e.g., for on-site urban and industrial wastewater)" of water.[21] Agriculture represents the dominant sector in water consumption

17 Mohamed El-Ashry, Najib Saab, and Bashar Zeitoon, eds., *Arab Environment: Water Sustainable Management of a Scarce Resource* (Beirut: Arab Forum for Environment and Development, 2010).

18 Taha Al-Farra, "Water Security in the Gulf Region," *Al Jazeera Centre for Studies*, March 31, 2015.

19 "Saudi Arabia's Great Thirst," *National Geographic*, last modified 2015.

20 Kieran Cooke, "Turmoil in Saudi water sector as country runs dry," *Middle East Eye*, July 10, 2016.

21 Afreen Siddiqi and Laura Diaz Anadon, "The water–energy nexus in Middle East and North Africa," *Energy Policy* 39, no. 8 (August 2011): 4529-540.

worldwide, even in the water-deficient countries of the Arabian Peninsula. On average, 85 percent of water resources in Gulf countries are dedicated to agriculture, compared to a global average of 70 percent.[22]

The interlinkages between water and energy are intensifying in the Gulf states, especially due to dependence on desalination and long-distance conveyance, which are among the most energy intensive (per unit volume) processes. A country like Saudi Arabia relies almost entirely on groundwater and desalinated water for oil extraction; while, at the same time, approximately 9 percent of the total annual electric power consumption is devoted to desalination and groundwater pumping.[23] These links in production and consumption of energy and water present a critical opportunity for improving sustainability in the management of energy and water resources.

On average, 85 percent of water resources in Gulf countries are dedicated to agriculture, compared to a global average of 70 percent.

A water-energy-food nexus approach that integrates management and governance across the three sectors can improve security and support the transition to a green economy. For instance, the implementation of water efficiency measures – such as reduction of the leakage in distribution networks or increase in utilization of treated wastewater in the industrial sector – could save natural energy resource assets (oil and gas), lessen the financial burden of the water sector, and reduce environmental degradation. In addition, investing in energy-efficient or renewable energy desalination technologies and water-pumping schemes can also result in mutual benefits that advance sustainability in both sectors.

Political Implications of Demand Management Policies

Over the last few decades, most GCC states have focused their strategies on augmenting water supply, without sufficient consideration to water demand management. Governments have issued generous water and energy subsidies that have stimulated wasteful consumption patterns, and escalations in demand for water-intensive amenities such as swimming pools, artificial lakes, and Golf resorts. In fact, water consumption levels in the Gulf rank among the highest in the world: The daily, per capita water consumption is 265 liters in Saudi Arabia, 500 liters in Kuwait and Qatar, and 550 liters in the UAE.[24] The daily consumption of Kuwait, Qatar, and the UAE is more than double that of the United Kingdom, which stands at just below 150 liters per capita.[25] At the same time, water subsidies represent an increasingly heavy burden on fiscal budgets, such that water subsidies are expected to exhaust 10 percent of oil revenue

22 United Nations Development Programme, *Water Governance in the Arab Region: Managing Scarcity and Securing the Future* (New York: United Nations Development Programme, November 28, 2013). For country level data, see also Mohamed El-Ashry, Najib Saab, and Bashar Zeitoon, eds., *Arab Environment: Water Sustainable Management of a Scarce Resource* (Beirut: Arab Forum for Environment and Development, 2010).

23 Afreen Siddiqi and Laura Diaz Anadon, "The water–energy nexus in Middle East and North Africa," *Energy Policy* 39, no. 8 (August 2011): 4529-40.

24 Hussein A. Amery, *Arab Water Security: Threats and Opportunities in the Gulf States* (Cambridge: Cambridge University Press, 2015).

25 United Nations Development Programme, *Human Development Report 2006* (New York: United Nations Development Programme, 2006).

in some GCC countries by 2025.[26] Table 1 shows the cost of water and electricity production, tariffs, and government subsidization rates in three GCC countries. The ranges in tariffs and subsidization rates correspond to different customer segments (usually citizens versus noncitizens) that pay different tariff amounts.

Table 1: Water and Electricity Production Cost, Tariffs, and Subsidy Rates in Select GCC Countries

Country	Product	Production cost (USD $)	Tariff (USD $)	Subsidization rate (%)
Bahrain	Electricity	0.07/kWh	0.01-0.04/kWh	43-86
	Water	1.92/m^3	0.80-1.06/m^3	45-58
Qatar	Electricity	0.07/kWh	0.02-0.04/kWh	42-67
	Water	2.74/m^3	1.21-1.92/m^3	30-56
UAE	Electricity	0.07-0.09/kWh	0.01-0.04/kWh	40-88
	Water	2.48/m^3	0.60/m^3	76-100

Omar Saif, Toufic Mezher, and Hassan A. Arafat, "Water Security in the GCC Countries: Challenges and Opportunities," *Journal of Environmental Studies and Sciences* 4, no. 4 (August 26, 2014): 329-46.

Water demand management includes the development of market and nonmarket incentives, mechanisms, and regulations that would reduce water use through greater efficiency. One of the recommendations of the Dublin Statement on Water and Sustainable Development in 1992 was that "water has an economic value in all its competing uses and should be recognized as an economic good."[27]

There is a misconception among some Western intellectuals who assert that Muslim countries avoid pricing water at its economic value due to religious and moral beliefs that treat water as a "free resource." Steven Solomon, for instance, suggests that religious beliefs are the reason why "many Muslim countries charged little or nothing except partial delivery costs in some of the driest parts of the world."[28] However, this is an inaccurate conjecture because Islamic law supports water tariffs and up to full-cost recovery for water services. Furthermore, Islam allows for the involvement of the private sector in water services, as long as it does not lead to private, exclusive "ownership over significant public water resources, or even long-term water use right."[29]

26 The World Bank, *A water sector assessment report on the countries of the Cooperation Council of the Arab States of the Gulf* (Washington, DC: The World Bank, 2005).

27 United Nations Development Programme, *Water Governance in the Arab Region: Managing Scarcity and Securing the Future* (New York: United Nations Development Programme, November 28, 2013).

28 Steven Solomon, *Water: The Epic Struggle for Wealth, Power, and Civilization* (New York: HarperCollins Publishers, 2010).

29 See Naser I. Faruqui, "Water, Human Rights, and Economic Instruments the Islamic Perspective," *Water Nepal* 10 no. 1 (2003): 197-214.

Gulf governments subsidize freshwater supply and consumption for reasons related to social and political stability, rather than Islamic law. The recent turmoil caused by the Saudi government's attempt to remove water subsidies to tackle its budget deficit is a clear example. The government's policy was met with public discontent, sparking a storm of protests on social media and causing the dissolution of the water and electricity ministry in April.[30] That is why most GCC countries prefer to rely on technological methods to save water, instead of getting residents to bear larger proportions of the financial burden for water and energy.

Some GCC states are also investing in awareness campaigns encouraging water conservation. In Qatar and the UAE, conservation campaigns educate the public through open access to online statistical information on utility websites.[31] Some utility companies in the UAE took this initiative one step further by showing the true cost of water and electricity production on the water and electricity bills of customers and how much they are saving via government subsidies.[32] The UAE is also leading the region in terms of partial privatization of the water and energy sectors.

Water as a National Security Issue

Redefining Security

As early as 1989, Jessica Tuchman Mathews issued a call to "redefine security" by broadening the definition of "national security to include resource, environmental and demographic issues."[33] Mathews argued that vulnerabilities brought by environmental change and degradation could lead to problems that endanger the security of countries and the welfare of whole populations. This argument is particularly relevant to Gulf Arab states, since their water challenges are far more pressing than what other regions may have encountered. In addition, as explained earlier, the interlinkage between energy and water production in the Gulf is stronger than in most other regions of the world.

Empirically, food was used as a "political tool" during the 1973 Arab-Israeli War.[34] The national security advisor to the U.S. president at that time, Henry Kissinger, threatened to meet Arab states' oil embargo with a "counter embargo" and stop food exports to the Arab world. Around the same time, U.S. Secretary of Agriculture Earl Butz affirmed that "Food is a weapon in the US negotiating kit."[35] Given that the United States is the world's largest grain exporter, such

30 Kieran Cooke, "Turmoil in Saudi water sector as country runs dry," *Middle East Eye*, July 10, 2016.

31 See "Conservation Tips," Abu Dhabi Distribution Company, accessed October 5, 2016; and "Tarsheed Guide," Qatar General Electricity & Water Co, accessed October 5, 2016.

32 See Laura Collins, "The real cost of water and electricity will shock you," *The National*, April 7, 2012.

33 Jessica Tuchman Mathews, "Redefining Security," *Foreign Affairs*, Spring 1989, 162-77.

34 See Hussein A. Amery, *Arab Water Security: Threats and Opportunities in the Gulf States* (Cambridge: Cambridge University Press, 2015); and Eckart Woertz, *Oil for Food: The Global Food Crisis and the Middle East* (Oxford: Oxford University Press, 2013).

35 Hussein A. Amery, *Arab Water Security: Threats and Opportunities in the Gulf States* (Cambridge: Cambridge University Press, 2015).

remarks by officials at the highest level of U.S. decision making represent a considerable threat to Arab food security. Indeed, the geopolitical impacts of the "food weapon" are the main driving forces behind food self-sufficiency programs in the Arab world.

Threats to Water Security

A substantial threat to water security in the Gulf is that, as water shortages become more severe, water supply networks become a critical target for terrorist objectives. Vulnerability of water infrastructure is a concern due to extensive delivery networks comprising tens of thousands of pipelines that deliver desalinated water from the shore to population centers hundreds of miles away. Pipelines of that length are vulnerable to technical failure or deliberate attacks arising from regional instabilities or domestic turbulence. Importantly, the frustrations of disgruntled foreign workers, as well as politicized ethnic or religious groups, represent a security threat to the host country in addition to the threat of transnational terrorist groups. The recent terrorist attacks targeting some of the holiest sites in Saudi Arabia in July[36] revealed that the threat of terrorism in the region is increasing.

A substantial threat to water security in the Gulf is that, as water shortages become more severe, water supply networks become a critical target for terrorist objectives.

The hazards of terrorism or a potential war with Iran are of growing concern to the United States and Gulf Arab states. Accordingly, the strategic location of the U.S. Navy's Fifth Fleet in Bahrain is perceived, in part, as protection for Saudi desalination plants, which are obvious soft targets for Iran in particular. Moreover, U.S. warships along with naval forces of the Gulf countries collaborate in obstructing the movement of terrorists and weapons of mass destruction-related technology in the Gulf and adjacent Arabian Sea.

The capacity and geographic location of desalination plants in the Gulf add to the fragility of the situation. In Kuwait, desalination plants are said to be located within the range of Iraqi and Iranian anti-ship missile placements. Moreover, increasing economies of scale in desalination entails that any failure of a mega-desalination plant for an extended period of time would cause significant social dislocation and political instability. For example, the gigantic Jubail Desalinization Plant in Saudi Arabia alone supplies Riyadh with more than 90 percent of its drinking water.[37] As Hussein Amery argues, in the case of a catastrophic failure at the Jubail plant, Riyadh would be uninhabitable and would have to evacuate within a week.[38]

In a similar vein, an imperative issue with depending on desalination for domestic water supplies is that desalination technology remains an imported technology for the GCC countries, with limited research and development directed toward adapting it to regional requirements. There is a real need for substantive research on the susceptibility of desalination plants in the

36 See "Saudi Arabia: Bombings target Medina and Qatif mosques," *Al Jazeera*, July 5, 2016.

37 Hussein A. Amery, *Arab Water Security: Threats and Opportunities in the Gulf States* (Cambridge: Cambridge University Press, 2015).

38 Ibid.

climatic and geopolitical contexts of the Gulf states. A significant terrorist threat in any of the Gulf countries could jeopardize daily operations of this technologically complex infrastructure by merely prompting an immediate departure of the professional expatriate class.

Alternative Solutions for Addressing Water Scarcity

Importing Physical Water

Some GCC states seriously considered several proposals for importing water from neighboring countries such as Iran, Turkey, or Lebanon. Nevertheless, most of these proposals were rejected as the geopolitical costs were thought to outweigh the potential benefits.[39] In the mid-1980s, the Gulf states negotiated a multilateral deal with Turkey over a dual pipeline project that would move water from the Ceyhan and Seyhan rivers in eastern Turkey to Gulf countries at an estimated cost of $22 million. This was considered a strategic oil-for-water deal, since the project was to be paid for by its primary beneficiaries in the Gulf. Later, in 2009, Qatar executed a feasibility study for a bilateral water import project that would transfer water from Iran's Karun River to recharge groundwater reserves and supply water for irrigation in Qatar. However, neither of these proposals was successful due to the perceived hydropolitical costs. In both cases, water importers in the Gulf were concerned that water-exporting countries could leverage their freshwater resources to serve geopolitical and foreign policy objectives.

...GCC states sought to preserve their water security by linking their water infrastructure and establishing a common water supply network.

As an alternative, GCC states sought to preserve their water security by linking their water infrastructure and establishing a common water supply network. In 2013, Gulf states agreed to build two giant desalination plants on Oman's Arabian Sea coast that will be linked via pipelines to the other states to supply them with desalinated water in case of a shortage.[40] Together these desalination plants will be able to produce 500 MCM of desalinated water per year with a total cost of construction of $10.5 billion: $3 billion for the desalination plants and $7.5 billion for the pipelines. Although this might not be the most cost-effective solution to water shortages, it is preferred by GCC states as it offers them a significant degree of control and security.

Importing Virtual Water

A vital component of GCC water security is the import of water embedded in water-intensive products – referred to as "virtual water." According to the World Water Council, "Virtual water is the amount of water that is embedded in food or other products needed for its production. Trade in virtual water allows water scarce countries to import high water consuming products while exporting low water consuming products and in this way making water available for

39 See Hussein A. Amery, "The Geopolitics of Water Scarcity," in *Water and Food Security in the Arabian Gulf* (Emirates Center for Strategic Studies and Research, 2013), 61-80.

40 Mary Sofia, "GCC Mulls Common Water, Power Policy," *Gulf Business*, January 13, 2014.

other purposes."[41] For instance, the production of one kilogram of wheat requires 1 to 2 m^3 of water, while one kilogram of beef requires 16 m^3 of water; one kilogram of cheese requires 5 m^3 of water and one kilogram of rice requires 3 m^3.[42] Thus, in an interdependent world economy, the rationale of comparative advantage suggests that water-scarce countries should rely on imported products with high levels of embedded water and save their limited water endowments for more financially productive uses.

As a result of population growth and increasing demands for food, virtual water trade is gaining momentum in the Arab region; it is estimated that around 50 percent of all food consumed in the Arab world is imported from regions that have sufficient water to produce beyond their domestic needs.[43] Generally, the amount of virtual water imported by Arab countries doubled from 148 BCM in 2000 to 310 BCM in 2010. Saudi Arabia and the UAE are among the highest net importers, with Saudi Arabia's virtual water imports representing an equivalent of 580 percent of its annual renewable water resources.[44]

Investing in Farmland Abroad

Triggered by the volatility of food imports and the global food crisis of 2008, Gulf countries have announced plans to invest in farmlands abroad in pursuit of enhanced food security. The aim of foreign direct investment in agriculture – either through land lease or land ownership – is to target countries that are endowed with favorable agro-climatic conditions, have good economic and diplomatic relations with GCC states, and are geographically close to reduce transportation costs. By investing in farmlands oversees, Gulf countries are effectively reducing overextraction of groundwater resources that are viewed as strategic reserves for hydrological emergencies, such as severe drought.

By investing in farmlands oversees, Gulf countries are effectively reducing overextraction of groundwater resources that are viewed as strategic reserves for hydrological emergencies…

Although farming abroad is a rational strategy for countries that do not have sufficient renewable water and arable land, this strategy is usually met with suspicions of "land grabbing." This is due to the lack of clear international laws governing the leasing or purchase of land across borders, and the absence of effective scrutiny over the terms and conditions of these contracts. Hence, Gulf states need to respond to the growing criticism of their foreign land acquisitions, taking into consideration the need for the support of local populations and recognizing that the actual food output of these lands is subject to climatic conditions. The attack on Saudi Star's farm in Gambela, Ethiopia by local gunmen in 2012, killing at least five workers and interrupting production for more than a month, is an example

41 The World Bank, *A water sector assessment report on the countries of the Cooperation Council of the Arab States of the Gulf* (Washington, DC: The World Bank, 2005).

42 United Nations Development Programme, *Arab Human Development Report 2009* (New York: United Nations Development Programme, 2009).

43 Martin Keulertz and Eckart Woertz, "Financial challenges of the nexus: pathways for investment in water, energy and agriculture in the Arab world," *International Journal of Water Resources Development* 31, no. 3 (March 10, 2015): 312-25.

44 United Nations Development Programme, *Water Governance in the Arab Region: Managing Scarcity and Securing the Future* (New York: United Nations Development Programme, November 28, 2013).

of the potential impact of local opposition on these projects' output.[45] As a result, some Gulf countries are seeking to expand their agricultural investments in developed countries, such as the United States and Australia, to minimize their exposure to social and political risks. A recent example was the purchase of 10,000 acres of farmland in Arizona by the Saudi food giant Almarai in 2014.[46]

Conclusion

Water scarcity is the fate of Gulf Arab states due to the geographic and ecological features of their lands. Over the past few decades, GCC states seemed to prioritize political stability and national security over economic efficiency and environmental sustainability in their water management policies. This strategy worked well during times of high economic growth and increasing oil revenue, along with a climate of social and political stability. However, the sustainability of an overdependence on desalination plants run by fossil fuels and the resilience of complicated water infrastructures require further inspections. Moreover, the interdependence between water, energy, and food security necessitate a high level of policy coordination at the national and regional levels. To preserve water security in the Gulf region, the long-term sustainability and perseverance of water management policies should be given more weight in evaluating alternative solutions for water scarcity.

45 "Work resumes at the Saudi Star project; Security tightened," *Awramba Times*, May 31, 2012.

46 See "Almarai acquires huge farmland in Arizona," *Arab News*, March 11, 2014; and Jeff Daniels, "Saudi Arabia buying up farmland in US Southwest," *CNBC*, January 15, 2016.