

National and Regional Water Security Policies in the Gulf States

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The issue of water resources has acquired increasing importance during the course of the twenty-first century, with talk of impending water crises – particularly in light of the changes occurring in the Earth's climate – that represent major environmental threats to human security.

Water is essential for survival and economic progress. Fresh water availability is a significant concern in many places around the world, particularly with a global population that grows by a quarter of a million people daily. As a result, the share of water supply per capita on the planet fell from 33,300 cubic meters (m³) per year in 1850 to 8,500 m³ per year in 1993. Roughly 40 percent of the world's population – mostly situated in developing countries – already faces severe water shortages, and ever more countries will join this list. It is conceivable that by the middle of next century about 65 percent of the world will face water stress or scarcity.

Contemporary analyses of fresh water crises show that demand for water during the twentieth century increased ten-fold; meanwhile, the world's population has quadrupled over the past hundred years. With increasing wealth, demand for water resources has increased. Global fresh water resources per capita will continue to fall if the current rates of increasing consumption endure—by 2025, there will be more than 3 billion people living in water stressed countries.¹

The water problem in the GCC countries is even more acute, since these countries are located in an arid zone almost completely devoid of any superficial, traditional fresh water sources – except some seasonal valleys in

Saudi Arabia, Oman and the United Arab Emirates – these countries depend mainly on securing sources of fresh water via sea water desalination, which meets over 40 percent of the total water needs of the region's population. The Arab Gulf countries rely on desalination as a major source of drinking water; it accounts for more than 80 percent, while the remaining demand is met by groundwater.² Thus, the concept of achieving water security in the Gulf overlaps with security-related dimensions relating to fresh water and its source, the saline waters of the Arabian Gulf. Consequently, it is not possible to talk about water security in isolation from the security of the waters of the Arabian Gulf itself.

The objective of this chapter is the study and analysis of the various dimensions of water security in the GCC countries, with a focus on policies for achieving water security across the Gulf. To this end, a key question is: what are the most prominent national and regional policies either adopted or proposed in the GCC countries to enhance water security? Other related areas of interest include: determinants of water security in the region; internal and external threats facing water security; strategies to face these threats at the national level; and policies to strengthen water security via a regional system for the Gulf countries.

The methodology of the study is based on hydro-political analysis – whereby political phenomena are analyzed in the light of the water situation. Hydropolitics is not a new concept; John Waterbury, a well-known aquaculture scientist, was the first to coin the term in 1979. Waterbury explains that the term refers to the degree of linkage between political phenomena and 'hydro-' phenomena, on the basis that such links should not be overlooked either in the process of analysis or in the implementation of water policies, especially at the national or international levels.³

The study is approached from an Integrated Water Resource Management (IWRM) perspective, which seeks to achieve water security alongside development goals.⁴ In general, IWRM can be defined as: "A set of procedures, policies and strategies taken at the local or regional level to control water resources and uses for the benefit of a community and region."⁵

Water resource management issues can be categorized as belonging either to supply management (activities to locate and develop new sources) or demand management (mechanisms to promote more appropriate levels and patterns of water use).⁶

*The Concept of Water Security
in a National Security Context*

In the early 1970s those concerned with international relations and strategic studies sought to redefine and broaden the traditional concept of “security” to include ‘non-traditional,’ non-military threats in the realms of politics, economics, and the environment.⁷

In this context, new concepts of security began to emerge in academic circles, led by “human security.”⁸ Other aspects include strategic security, economic security, environmental security, water security, food security, energy security, and so on. Thus, water security therefore features as a component in a comprehensive view of national security.

Undoubtedly, water is one of the most influential resources determining human security; since it is a critical factor in human survival. Hence, securing access to water is one of the main objectives in pursuing human security. Of course, water security is also linked to food security.⁹ Perceptions of water security are strongly affected by water scarcity, where shortages in water supplies are seen as a tangible indicator of a lack of water security.¹⁰

Definitions of water security vary among researchers, according to their intellectual tendencies and academic backgrounds. However, it could be argued that there is an acceptable and well-known definition among researchers and hydropolitics specialists: “the provision of appropriate amounts of water – of good quality that is fit for human consumption – needed to fulfill development goals and domestic requirements, as well as sufficient availability of water infrastructure to provide clean drinking water and sanitation, and the ability of the state to secure those resources and protect them from external and internal threats.”¹¹

According to this definition, five key indicators of water security can be identified, namely: a quantitative indicator, a qualitative indicator, an economic indicator, a military force indicator, and an indicator based on water conflicts. This analysis will not take into account the military power indicator; nor will it consider the final indicator, as the Arab Gulf states are not riparian states.

The Quantitative Water Security Indicator

Water security is directly linked to the water balance of a given state or region, and describes the relationship between water supply and demand.¹²

The water balance is characterized by its status as either:

- balanced (when demand equals supply);
- surplus (when supply exceeds demand); or
- deficit (when demand exceeds supply).

Water security is a relative concept, as different levels of water security in different countries will be determined according to their level of development.¹³ Furthermore, it differs according to the criteria by which it is determined;¹⁴ there are a multitude of indicators and benchmarks upon which we can rely to determine the level of water scarcity, but Seckler and Silva present a number of indicators that can be used as a basis for determining water scarcity.¹⁵

The term “water scarcity” denotes one of two cases: The first is water poverty, which refers to areas with an annual water supply per capita of less than 1,000 m³—the so-called global water poverty line. The classifications are as follows:¹⁶

- Water surplus countries: with annual per capita water resources of more than 2,000 m³.
- Water-stressed countries: with annual per capita water resources of 1,000–1,700 m³.
- Water-scarce countries: with annual per capita water resources of less than 1,000 m³.
- Acute water shortage: countries with annual per capita water resources of less than 500 m³.

However, it is not sufficient to determine water security according to available water resources per capita alone, as this indicator is falling in almost all countries of the world as a result of population increases. Therefore, the productive and economic return derived from each unit of water must also be measured. A developed country can exist with an acute shortage of water per capita (less than 500 m³), while a developing

country suffering from social and economic problems might not survive on less than 1,000 m³ per capita. Therefore, many experts refuse to accept the figure of 1,000 m³ per capita per year as a useful measure of water poverty.

Another measure is “water deficit,” in which the level of demand for renewable water resources outstrips supply, creating an imbalance that is sometimes referred to as the “water gap.” When such a deficit leads to economic and social disruption which threatens the security of the state, it becomes known as a “water crisis.”

Some experts believe that a deficit in the water balance – irrespective of the water poverty line – is sufficient quantitative evidence of water resource scarcity.¹⁷

The Qualitative Water Security Indicator

According to this indicator, water scarcity denotes the limited suitability of existing water supplies to meet the demands of a developed/developing nation (home, agricultural and industrial)—namely poor water quality. Water resource experts confirm that when water is available in large quantities but is not suitable for drinking or sanitation, this can be characterized as water scarcity.¹⁸ Specialists propose that “drinkable water” should therefore determine water security, even if water of poor quality is available in abundance.¹⁹ A report released by the US Environmental Protection Agency in April 2006 confirms that any kind of pollution of water resources comprises a threat to water security.²⁰

The Economic Water Security Indicator

According to this indicator, water scarcity is determined by the extent of the lack of available financial resources with which to create the infrastructure needed to achieve and maintain water security. Even though water of sufficient quality and quantity might be available to meet a population’s needs in terms of drinking water, sanitation and irrigation, a nation may lack the infrastructure necessary to deliver these resources to end-users as a result of limited financial resources. Users are therefore deprived of water in the same way as those who face a complete lack of water resources.²¹

In this context, experts talk of the basic human right of access to water as an expression of an economic indicator of water security. The human right to water can be measured on the basis of the two indices stated in Human Development Report issued by the UNDP in 2006, namely: the proportion of people who use pure drinking water supplies, and the proportion of people who use treated wastewater.²²

Water Security in the Arab Gulf States

Water in the Arab Gulf states can be divided according to three main sources: the first is groundwater, including surface water wells which usually rely on monsoon rains for replenishment, and the deep wells that provide access to ancient geological formations; the second is sea water desalination and purification; and the third is the treatment and recycling of wastewater—which is somewhat of a novelty in the Gulf states and is only used for irrigation in agriculture.²³

The following section will apply the four indicators outlined above to the Gulf states.

The Quantitative Indicator Applied to the Arab Gulf States

The Arab Human Development Report of 2009, issued by the UN Development Program, confirmed that water scarcity continues to pose a major challenge to human security in the Arab countries in general, and the Arab Gulf countries in particular. It suggests the possibility of addressing water scarcity challenges through adopting integrated water resources management (IWRM) policies, in the form of water supply and demand management mechanisms.²⁴

As stated previously, the water poverty line is often considered to be 1,000 m³ per capita per year, while if resources are below 500 m³, the country faces an acute water shortage.²⁵

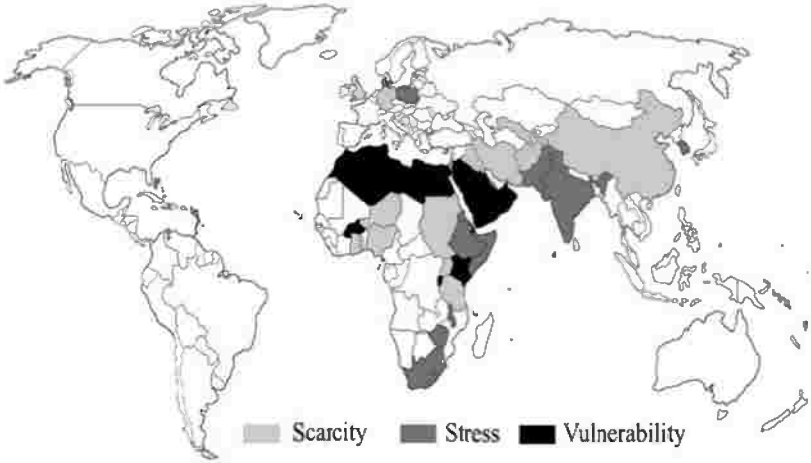
According to the quantitative indicator, there are thirteen Arab countries that fall below the water poverty line, including all of the Arab Gulf states. The report, issued by the United Nations Economic and Social Commission for Western Asia (ESCWA), discusses water stress in the Arab countries, differentiating between four levels of severity: slight, significant, serious, and critical.²⁶ This level of water stress worsens as population growth rates rise.

Table 5.1
Levels of Water Stress in Thirteen Arab Countries (2006)

Critical water stress (More than 10,000 persons per million cubic metres)	Serious water stress (Between 5,000 and 10,000 persons per million cubic metres)	Significant water stress (Between 2,500 and 5,000 persons per million cubic metres)	Slight water stress (Less than 2,500 persons per million cubic metres)
Kuwait	Bahrain	Jordan	Egypt
UAE	Iraq	Saudi Arabia	Lebanon
	Occupied Palestinian Territory		Oman
	Qatar		Syria
	Yemen		

Source: United Nations Development Program (UNDP), *Challenges to Human Security in the Arab Countries*, Arab Human Development Report 2009, UNDP Regional Bureau for Arab States (New York, NY: UNDP, 2009).

Figure 5.1
Areas of Limited Water Availability, 2008



Source: Based on World Resources Institute (WRI), 2008.

Each Gulf country suffers from an acute water shortage, according to the quantitative indicator, where water share per capita does not exceed 500 m³ per person per year.

Figure 5.1 shows areas of the world that experience the most severe levels of water stress according to fresh water available per capita annually in 2008, based on estimates by the UN Food and Agriculture Organization and the World Resources Institute (WRI).

The map shows that all Arab Gulf states are categorized as vulnerable in terms of their lack of water resources. There is no doubt that population trends play a key role in water demand, and this is certainly true of the Arab Gulf states. Rapid population growth has increased the severity of the water scarcity faced by these countries. Although natural factors such as intermittent periods of drought and limited reserves of fresh water can cause water scarcity, overpopulation adds the greatest pressure.

Table 5.2 shows the evolution of the populations of the Arab Gulf states. The region's population grows by two percent per annum, and the highest growth rate is found in Saudi Arabia (2.9 percent). If these rates endure, the combined population of these countries will double within roughly 26 years.²⁷

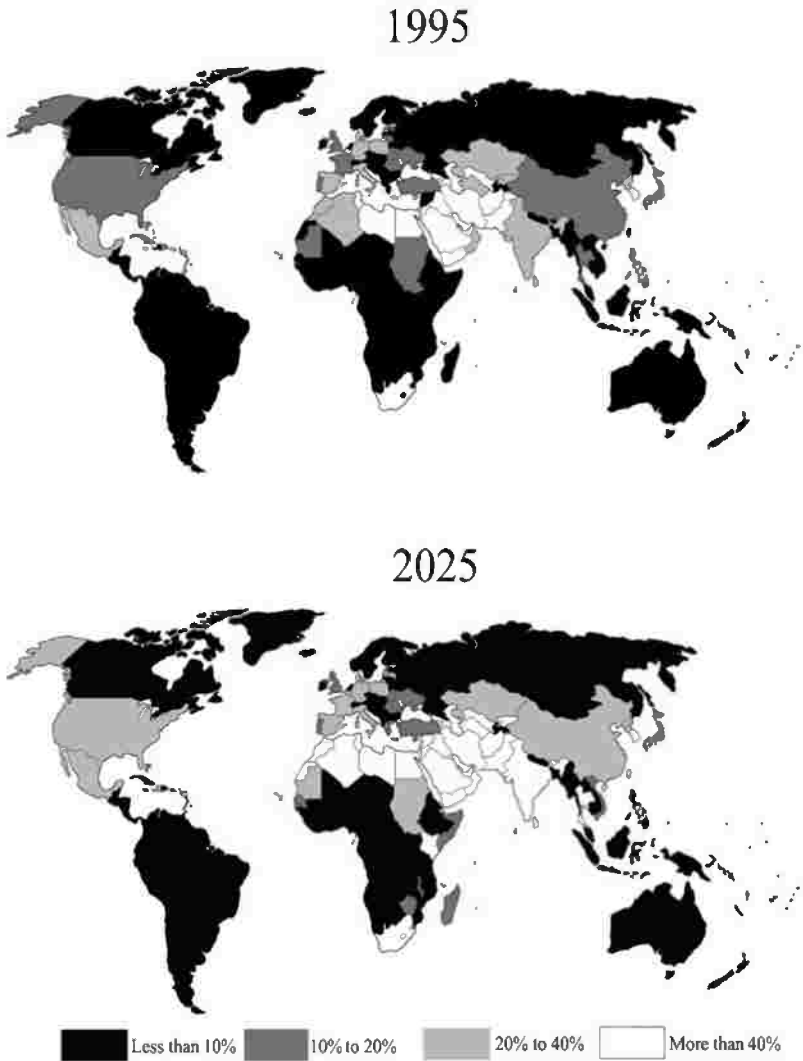
Table 5.2
Demographic Indicators in the Arab Gulf States, 2009

Country	Fertility rate	Annual population growth rate	Population (million)
UAE	3.0	1.4	8.2
Bahrain	2.6	1.8	1.2
Oman	4.1	2.5	3.2
Qatar	3.5	1.6	1.6
Kuwait	4.0	1.7	2.6
Saudi Arabia	5.7	2.9	25.4
Total	3.8	2	42.2

Source: Secretariat General of the Cooperation Council for the Arab States of the Gulf (GCC), Population and Vital Statistics (<http://www.gcc-sg.org>).

Figure 5.2

Withdrawal Rates of Available Fresh Water 1995/2025



Source: based on: <http://developmentupdates.blogspot.com/2011/02/middle-east-and-mena-region.html>).

Figure 5.2 shows the estimated growth in fresh water withdrawal rates between 1995 and 2025. The map shows that all the Arab Gulf states – with the exception of the Sultanate of Oman – were experiencing severe water shortages in 1995. By 2025, Oman will join the rest of the Arab Gulf states with acute water shortages with a water share per capita of less than 500 m³ per year.

Table 5.3

Annual Renewable Fresh Water per Capita in the Arab Gulf States, 1970/2000/2030

Country	Total fresh water renewal (km ³ /year)		Fresh water renewal per capita (m ³ /year)		
			1970	2000	2030
UAE	0.2		897	77	56
Bahrain	0.1		455	156	108
Oman	1.0		1383	394	164
Qatar	0.1		901	177	129
Kuwait	0.02		27	10	6
Saudi Arabia	2.4		418	118	54
Total:	3.82	Average:	680.16	155.34	86.16

Sources: United Nations, World Population Prospects 2000 (UN, 2001); and P. Gleick, et al., *The World's Water 2002–2003: The Biennial Report on Freshwater Resources* (New York, NY: UN, 2002), Table 1.

Kuwait has almost no renewable fresh water and relies almost entirely on non-traditional sources such as desalination to meet the water needs of its people.²⁸

In a study on the future of water in the Arab region,²⁹ the Arab Organization for Education, Culture and Science and the Arab Center for the Study of Arid Zones and Dry Lands, predicted the emergence of severe water shortages in the Arab Gulf by 2030.³⁰

The Qualitative Indicator Applied to the Arab Gulf States

The problems faced by the Arab Gulf states do not relate to the quality of water resources, as these countries depend on groundwater to secure more than 50 percent of their water needs.³¹ However, desalination is used to

secure the remaining share of demand, and any pollution in the waters of the Gulf necessarily affects the water security of these states.

Hence the security of fresh water supplies is entwined with that of the salty waters of the Gulf, as the latter provides a large proportion of the water resources of the region. Therefore any consideration of water security in the region must consider the security of the Arabian Gulf itself. In general, there are three basic sources of threat to the Arabian Gulf:

The first is climate change. Global warming will lead to changes in the hydrological patterns of the Earth that determine the availability of water. Predictive models indicate a variety of complex outcomes; however, the most important implication is that most regions of the world affected by water stress will face even more severe shortages, and the ability to predict the size and character of future water resources will become ever more difficult, rendering these areas vulnerable to more extreme water crises.³² Climate change will result in a significantly lower rate of water availability in the countries of the Arabian Peninsula due to lower rates of rainfall and high temperatures leading to increased evaporation rates in Arabian Gulf waters. Consequently, salinity will increase, requiring greater resource consumption and technological advancement in the desalination industry.³³

The second is contamination of the waters of the Arabian Gulf. The main objective of establishing desalination plants is to provide alternative sources of water to meet domestic needs when groundwater is insufficient. However, desalination continues to increased salinity; consequently, it results in changes to the natural characteristics of the Arabian Gulf. Furthermore, the vast array of industrial activities and commercial traffic in Gulf waters and the resulting pollution will push up the costs of desalination and is, therefore, a threat to achieving water security in Saudi Arabia, Kuwait, Qatar, the UAE and Bahrain in particular, as these countries rely heavily on sea water desalination.³⁴

The third is the risk of radioactive pollution of Gulf waters posed by the nuclear facilities at Bushehr on the Iranian coast. Should nuclear waste affect the quality of water in the Gulf it could necessitate substantial additional investment to ensure the quality of the desalinated water and guarantee the removal of any radioactive pollutants.

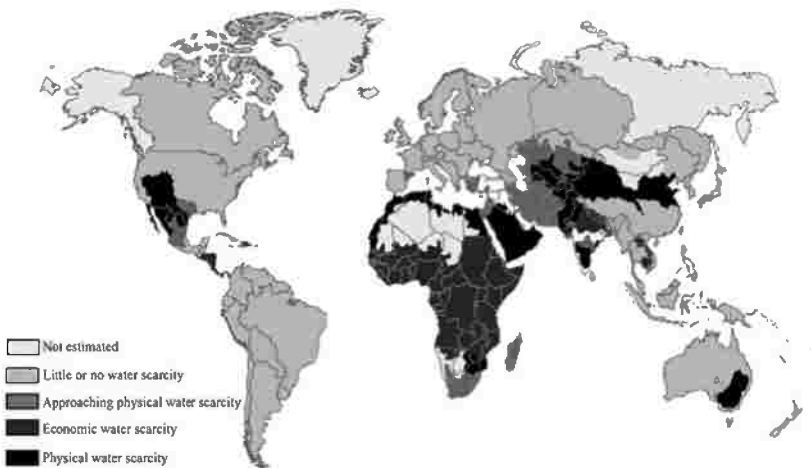
The Economic Water Security Indicator Applied to the Arabian Gulf

Water security is limited by a lack of availability or insufficiency of physical and/or economic resources with which to establish the necessary infrastructure to distribute water to users for drinking, irrigation, etc.³⁵

The Arab Gulf states do not suffer any problems in this regard owing to their substantial financial resources that enable them to establish and build infrastructure to supply drinking water and improved sanitation, using plants for pumping, desalination and distillation. Figure 5.3 shows areas of physical and economic water insecurity.

Figure 5.3

Areas of Physical and Economic Water Scarcity, 2006



International water Management Institute (IWMI), “‘Insights’ from the Comprehensive Assessment of Water Management in Agriculture,” Stockholm World Water Week, 2006, p. 8 (http://www.iwmi.cgiar.org/assessment/files_new/publications/Discussion%20Paper/InsightsBook_Stockholm2006.pdf).

The economic indicator, when applied to the Gulf States, shows that there is a progress in efforts to construct water infrastructure related to the distribution of clean drinking water and improved sanitation, in accordance with the two main measures outlined in the 2006 UNDP Human Development Report; namely the proportion of people who have

access to clean drinking water, and the proportion of the population benefiting from suitable sanitation (see Table 5.4).

Table 5.4
Water and Sanitation in the Arab Gulf States

Country	Human development rank	Population using improved sanitation (%)	Population using improved sources of water (%)	
		2009	2007	2009
UAE	30	98	100	100
Bahrain	42	-	-	100
Qatar	3	100	100	100
Kuwait	63	-	-	-
Saudi Arabia	56	-	-	90
Oman	89	-	-	83

Source: UNDP, *Human Development Program*, 2007/2009 (New York: United Nations, 2007/2009).

The table shows that some of the Gulf states have managed to improve sanitation and water supply for their entire populations. These countries are Qatar, the UAE, and Bahrain.³⁶ Hence it is clear that the Arab Gulf states do not suffer from a lack of economic potential to improve water infrastructure such as pumping stations, water purification and desalination plants, and water supply networks.

National Water Security Policies in the Arab Gulf States

There are many different means of water management on the demand side which seek to reduce demand through promoting more rational levels and patterns of water use.³⁷ Researchers recommend³⁸ the use of modern techniques in irrigation, privatization and pricing of water, reduced subsidies on water consumption in urban areas, water quota systems and re-allocation of water resources to other sectors, and the development of greater water awareness among the public. These measures come within the framework of a new water management

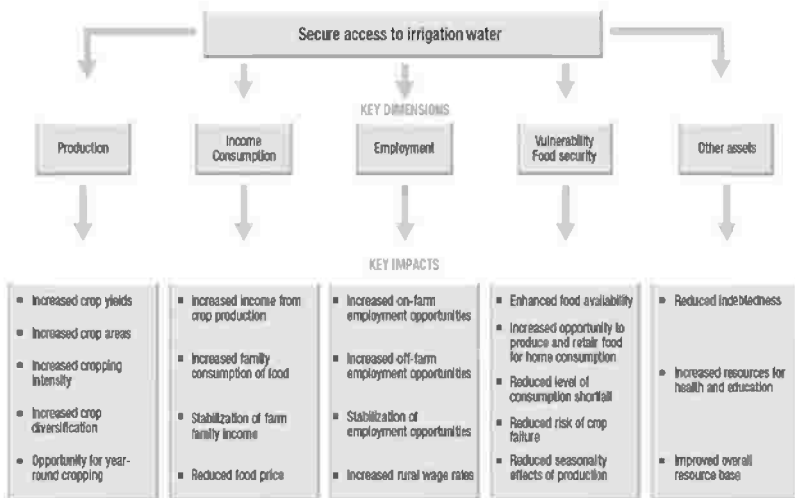
strategy from the World Bank based on demand-side management as an alternative to the prevailing trend of supply management.³⁹

Modern Irrigation Techniques

Owing to the steady rise in the value of water, it is important that advanced water techniques be adopted such as drip irrigation, the use of low-cost plastic pipes, mist irrigation, and automated control systems in order to reduce consumption and increase efficiency. Rosegrant (1991) highlighted the inefficiency of most traditional irrigation systems used in developing countries, describing their efficiency to be between 25 and 40 percent.⁴⁰ Such inefficiency results in the wastage of large amounts of irrigation water. Meanwhile, if modern irrigation systems such as sprinklers and drip irrigation were used, water efficiency could reach as high as 80 percent. Furthermore, water wastage during the course of its flow from sources to agricultural land through dirt channels is significant, and could be reduced by using concrete channels or plastic piping.⁴¹

Figure 5.4

Poverty Alleviation and Access to Irrigation Water



Source: United Nations Development Program (UNDP), "Beyond Scarcity: Power, Poverty and the Water Crisis," *Human Development Report 2006* (New York, NY: United Nations, 2006), p. 175.

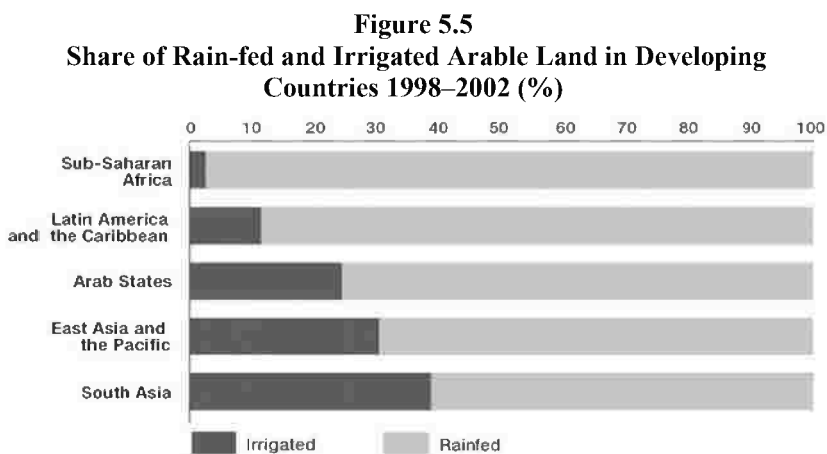
A report issued by the World Bank in 1990⁴² found that irrigation systems serving more than half of the irrigated land worldwide require modernization. Furthermore, most irrigation systems in developing countries do not utilize their full capacity. Studies indicate that access to irrigation water and modern irrigation techniques can help to reduce poverty and water vulnerability (see Figure 5.4).

The study, prepared by Burt et. al., confirmed that the introduction of modern irrigation systems would raise irrigation efficiency and maximize the agricultural production, thereby increasing economic returns.⁴³

Caruthers emphasizes the importance of taking into account social dimensions of the application of modern irrigation technology,⁴⁴ while some experts warn of related environmental impacts.⁴⁵

Irrigation specialists now speak of four modern techniques, namely surface irrigation, subsurface irrigation, sprinkler irrigation, and drip irrigation. The decision as to which to employ depends on several factors, including the type of soil, the nature and quantity of the water source, the topography of the land, prevailing climatic factors, the type of crop, and other economic and social factors. Many studies have dealt in detail with irrigation methods, and the pros and cons of each.⁴⁶

In the Arab countries we find that less than 25 percent of total arable land depends on irrigation. (see Figure 5.5).



Source: UNDP, "Beyond Scarcity: Power, Poverty and the Global Water Crisis," op. cit., p. 177.

In this context, the Arab Gulf states have gone to great to introduce modern and sophisticated irrigation techniques, but the challenge facing these countries is the need to standardize these systems of modern irrigation for use in all other agricultural sectors, and in all regions.

Using Brackish Water for Irrigation

Brackish water, found beneath deserts, inland lakes, and in the form of agricultural drainage, is used to irrigate suitable crops and plantation trees in deep sandy soil.⁴⁷ Brackish water can also be mixed with fresh water for agricultural or industrial purposes. The Arab Gulf states are a long way from exploiting the full potential of brackish water, and related policies have only been implemented to a limited extent.

Developing Water-efficient Plant Strains

In seeking to achieve food security, it is necessary to utilize genetic engineering to provide the largest possible agricultural yield with the lowest amount of available water. Researchers have taken advantage of the amazing advances in genetic engineering to develop plant species strains which require less water, are more tolerant of drought and hot climates, and which can be irrigated with water that is high in salinity. Perhaps the best examples are special species of wheat and rice, hybrid maize – which dramatically increases corn productivity – and certain resilient varieties of vegetable and fruit.⁴⁸ As a result, governments can guard against water constraints in the future at relatively low expense by increasing funding for agricultural research centers working to develop new breeds of efficient crops.

Some Arab countries have already benefitted from genetic engineering,⁴⁹ however, the Arab Gulf states are still far from developing this sector.

Crop Distribution

Research suggests that modified crop distribution is the most basic mechanism for rationalizing water consumption, either by reducing the proportion of crops that require large amounts of water, or by redistribution of crops within cultivated areas to fully exploit varying rates of water consumption in light of changing climatic and environmental conditions.⁵⁰

Crops differ in terms of their life cycles, water needs, and suitability to different conditions. Some crops are characterized by long life cycle, such as sugar cane, which consumes large amounts of water. Wheat, on the other hand, has a short life cycle and does not consume as much water.⁵¹

A study prepared by the Agricultural Reform Policy Project (APRP) of the Egyptian Ministry of Agriculture, in cooperation with the US Agency for International Development (USAID), recommended in 1998 that areas be dedicated to rice cultivation, that early maturing rice breeds be used, that water management should be improved in areas of rice cultivation, and finally that taxes should be cut on rice imports.⁵²

Ahmed Sayyed El-Najjar agrees and proposes to add a stipulation that crop choice be confined to so-called “influential crops.”⁵³ Studies also suggest that the Arab Gulf states need to adopt similar measures urgently to enhance their water security.⁵⁴

Multi-sector Redistribution of Water

The redistribution of water based on efficiency and productivity is a key mechanism in adapting to the constraints imposed by limited water resources—although there are very few countries that are willing to divert water away from irrigation for use in industrial and domestic applications.

Given the fact that the irrigation sector accounts for roughly 80 percent of water use in the Arab Gulf states, a proportion that estimates indicate is likely to endure at least up to 2025,⁵⁵ the transfer of a relatively small percentage of irrigation water to other uses could assist in eradicating shortages in other sectors and raising productivity.

Ziauddin Elkoussy states that water allocation is now being discussed with some urgency at the regional and international levels, and within most international organizations concerned with water. Talk of water allocation has given rise to the concept of “quota efficiency,” through which areas may be identified where water returns can be maximized based on economic feasibility as well as social, political and security indicators.⁵⁶

Water Awareness: Building a Sustainable Water Culture

Efforts to educate societies through public education programs and similar initiatives have lead to significant changes in human behavior in terms of water use and conservation. Most of these efforts cost almost nothing compared with other investments in the water sector, and they should be encouraged and supported in the countries of the region. All water management efforts would be in vain without public willingness to participate directly or indirectly in water management. It is therefore necessary to build public awareness and enlightenment, distribute expertise to all who can benefit, and provide incentives for work that contributes to the sustainability and equitable distribution of clean water, irrigation water and sanitation services among all sections of society.

There is much evidence to suggest a distinct lack of awareness among the countries of the Arab world in particular, and the developing world in general, concerning the importance of water and its value to the process of development, including how to rationalize use, maintain supplies and protect water resources from pollution. This lack of awareness is manifested by infringements of crop restrictions, violations of environmental legislation, and wasteful domestic and industrial uses of water.

Large quantities of water can be saved and directed to other development uses if additional efforts are made to promote water awareness. Various actors can play a vital role in this regard; from families – by instilling the value of conservation and responsibility in children – to schools, universities, and houses of worship, and various elements of the mass media.

The *Population and Development Report* issued by the UN Economic and Social Commission for Western Asia (ESCWA) in 2003,⁵⁷ confirms that the concept of water conservation has gradually been introduced via curricula and the media throughout the Arab countries.

In the case of Saudi Arabia, for example, we find that the government understands the problems associated with a dry, harsh climate, limited sources of water, and growing water demand. It has created bodies specialized in water production and distribution, established laws and implemented measures such as the adoption of new pricing policies and methods to detect and prevent leakage. *Fatwas* have also been issued by

Islamic law to manage water demand effectively.⁵⁸ Also, subsidies for wheat production have been cut, leading to a decline of 25 percent in demand for irrigation water. Moreover, a *Fatwa* issued allowing the re-use of wastewater – particularly in irrigation – has led to the re-use of millions of m3 of treated wastewater each year. Saudi Arabia encouraged the re-use of (treated) industrial wastewater, and various plants are now committed to treating and distributing this resource.⁵⁹ Other measures have been taken to control well-drilling and monitor water consumption on farms in order to avoid excessive overuse. Farmers are encouraged to use modern irrigation systems, and work by virtue of irrigation timetables in order to minimize water demand.⁶⁰

National Water Security Policies in the Gulf States: Managing Supply

There are many ways in which water resources may be developed and their use rationalized both in developed countries and many developing countries. Resource development projects include the construction of dams and water reservoirs, organizations to establish rights to wells, and networks of distribution canals.⁶¹

In this context, water specialists recommended using certain techniques via which to cope with limited water resources, including:⁶² establishing tanks to collect water before reaching estuaries, rainwater harvesting using excavation and covered or un-covered ground reservoirs, and increasing strategic underground water reserves by diverting streams.

Seawater Desalination

Desalination refers to any process that removes salt and other minerals from water.⁶³ Leon Awerbuch confirms that current technologies allow the production of large amounts of water of a high purity through desalination.⁶⁴

Globally, there are now more than 5,700 desalination units, with a total capacity of 100 mcm per day. Desalination plants operate in 105 countries, are manufactured by 170 companies throughout the world. The four states that rely most heavily on desalination are: Saudi Arabia, Kuwait, the United Arab Emirates, and the United States.⁶⁵

Seawater desalination is still expensive, despite a fall in costs associated with the process, and the higher the salinity of the water the more expensive the process becomes. Moreover, the issue of the use of seawater desalination is entwined with a variety of economic and financial issues—in particular the cost of desalination compared to GDP per capita, especially in countries that do not enjoy cheap energy resources, environmental issues related to brine drainage, and manpower training and technology transfer.⁶⁶ Recent studies indicate that desalination in the future will likely be powered by solar or nuclear energy.⁶⁷

Some studies suggest that annual demand for desalinated water in the Arab Gulf states will reach 5.4 bcm by 2030. Considering the wealth of these countries, and the fact that 97 percent of the world's water is salty, it would indeed be possible to produce this quantity of desalinated water; however, it would have negative economic effects. The opportunity costs of such an approach in the Gulf states, however, would be high, and would necessarily affect other aspects of development.⁶⁸

Treated Wastewater Usage

With the increasing scarcity of fresh water and the growing demand from cities, increasing amounts of treated wastewater from cities could potentially be used for agricultural irrigation. With appropriate treatment and care, wastewater that is processed, purified and then reused could be of great benefit.⁶⁹

An overview of the possibility of the use of treated wastewater for irrigation featured in a report prepared by the World Bank which concluded that the re-use of waste water could bring important commercial and environmental benefits.⁷⁰

Treated wastewater can be used for irrigation according to the guidelines set by the World Health Organization (WHO). These guidelines necessitate the division of irrigation into 'restricted' and 'unrestricted' categories. The quality of the wastewater used depends on the application.⁷¹

Saudi Arabia has expanded its use of treated wastewater following a *fatwa* issued in 1978. In 1995, the kingdom re-used 15 percent of water in for palm tree irrigation. Moreover, the water used for ablutions in the Two Holy Mosques in Mecca and Medina is reused to flush toilets instead of

using costly desalinated water. In Kuwait, 1,700 hectares (ha) of land is irrigated with treated water used to grow garlic, onions, eggplant and pepper (in accordance with WHO guidelines).⁷²

The cost of processing wastewater differs according to the intended use, as well as the costs of treatment, equipment, labor, and transport. Studies conducted in the United States estimated that in 1983 the cost of the process ranged between 10¢ and \$1 per cubic meter. In the Gulf states the figure was 40¢ in the early 1980s. The industrial reuse of water for cooling purposes (which requires the least amount of processing and the largest amount of water) is estimated at about 10¢ per cubic meter. The cost of water re-use for agricultural purposes is one of the cheapest, since water treatment is limited to primary treatment.⁷³

Harvesting Rain Water

Collecting and diverting rain water to irrigate field crops involves the construction of reservoirs to collect the rainwater instead of allowing it to seep into the ground.⁷⁴ This plays an important role in the desert, as it provides drinking water for livestock; it is also used in isolated areas that do not have ready access to nearby water sources.

Water is usually stored in areas around rivers, or in artificial lakes, ponds, tanks, wells, rooftops, streets, etc. If the aim is to replenish groundwater, the water is stored underground. The amount of harvested water depends on the amount of rainfall, its intensity and distribution, and what can be collected.⁷⁵

This strategy has received little attention in the Arab Gulf states, despite the fact that it can be used effectively in the coastal areas in the Arab Gulf states, which are known for their high rates of rainfall during winter.

With regard to the costs of harvesting rainwater, there is a clear disparity in cost according to the method employed. These costs have been studied by the University of Arizona, which determined that the cost per cubic meter of water ranged from 17¢ when using processed land (by removing stones and plants), and 53¢ when using plastic sheeting that fastened on stones, both based on a region with an annual rainfall of 250 millimeters. This cost is reduced to 8¢ in the first case and to 26¢ in the second when rainfall reaches 500 mm per year.⁷⁶ This method is used in

some semi-arid areas of India and Pakistan.⁷⁷ Although many researchers confirm the effectiveness of harvesting water to increase productivity in dry areas, it is not the best solution for the production of crops in harsh environmental conditions.⁷⁸

Strategic Storage

Strategic storage refers to reserves of water stored underground for distribution in an emergency situation to satisfy basic needs until normal production and distribution can resume.

The concept of strategic reserves is simple in countries that have natural freshwater, surface water or groundwater, and sufficient rainfall to supplement annual consumption through storage in underground reservoirs, dams or lakes. In this case, strategic stocks comprise quantities sufficient for long-term consumption ranging from four months to one year.

In the Gulf states, where water sources are scarce, the development of strategic supplies is quite different; as water resources are generally produced via desalination it is not possible to produce and store very large amounts in superficial tanks, as they require constant maintenance and attention, and may be exposed to contamination. In such cases, strategic stocks can be stored in deep underground reservoirs, where they do not require the same level of ongoing treatment as surface reservoirs.

Kuwait has extensive experience in this area, having spent exorbitant sums building storage capacity in concrete towers and ground tanks – with a capacity of approximately 2,000 million gallons – to meet demand for short periods in an emergency. So far, around 100 million Kuwaiti Dinars (KWD) have been invested in this infrastructure.

If Kuwait were to construct enough concrete water tanks to maintain sufficient strategic stocks for a year, for example, it would require around 45,000 million gallons at an estimated cost of KWD 2.5 billion. Moreover, 40 square kilometers of land would be required, based on the assumption that the reservoirs were five meters high. It would be difficult to treat and maintain such quantities in a state that is safe to drink. Even in an emergency when consumption is regulated (limited to 30 liters per person for drinking and cooking for a population of two million people), daily consumption in Kuwait is estimated at 13 million gallons. To cover

the needs of a full year under emergency conditions, the reservoirs would need to have a capacity of 4,750 million gallons at least, at an estimated cost of KWD 260 million.

The Ministry of Electricity and Water in Kuwait commissioned the Kuwait Institute for Scientific Research to conduct a preliminary study assessing the feasibility of artificial injection into underground reservoir. The focus of the study was the Dammam aquifer at the Sulaibiya and Al-Shaqaya fields, as well as an underground water reservoir in the Sulaibiya field. So far the results of the survey at the Dammam reservoir have shown it to be technically and economically feasible. However, further investigation is required to determine what quality of water should be injected into the reservoir.⁷⁹

Strategic storage and recovery from aquifers is a relatively new concept in the Arab Gulf. Abu Dhabi has adopted a groundbreaking pilot project – the likes of which has not been attempted in the region – for strategic storage of water by artificial injection in Liwa in the Western Region of the emirate. Feasibility studies for the project began in 2002 and were completed in 2004, and testified to the utility of the plan, and recommended a pilot project be established to inject water into five formations. The pilot project achieved an efficiency in the range of 85 percent, and following the end of the project in 2005 the Abu Dhabi Executive Council approved a further project to store sufficient water to last 90 days in an emergency situation, with the possibility of expanding the capacity to reach one year.

The strategic aquifer has the ability to store 3.5 billion gallons of water, with the potential for expansion to 30 billion gallons, while the largest surface reservoir in the UAE has a capacity of no more than 90 million gallons. The project has revealed the high economic feasibility and low cost of the infrastructure (80 fils per gallon) compared to alternatives (3.5 dirhams), the low environmental impact and land use required, and has proved the concept to be a suitable replacement for other methods of storage, with an efficiency of up to 83 percent compared to for example, 77 percent in the US.⁸⁰

Water will now be injected into the formation, beginning this year 2013 and continuing until 2015, at seven million gallons per day. The initial cost of the project is estimated at 1.611 billion dirhams.⁸¹ It is

noteworthy that the Environment Agency–Abu Dhabi (EAD) has also commissioned a feasibility study and a pilot project for strategic storage in Shuwaib in the eastern region of the emirate.

Regional Water Security Policies in the Arab Gulf

There are many similarities among the Arab Gulf states in terms of their hydrological characteristics. They all share the same threats to their water sources, and all derive the large part of these resources from the same body of water – the Arabian Gulf. Hence, in some ways the Gulf states could already be viewed as a ‘regional water system.’ Therefore regional water security policies are naturally based on the inevitability of ‘water cooperation’ and the necessity of ‘hydrological interdependence.’

International cooperation is an effective mechanism for ensuring the shared benefits of water resources, as well as containing and resolving water conflicts between states. In their 1985 study, Naff and Frey state:

“Precisely because it is essential to life and so highly charged, water, unlike most other volatile issues of international relations, can-perhaps – even tends to – produce cooperation even in the absence of trust between the concerned actors.”⁸²

In the same year Caponera identified the most important principles of international water law, which encourage water cooperation.⁸³ In 1992 Rogers provided an analysis of the economic benefits derived from water cooperation. He concluded that such cooperation would help to achieve sustainable development.⁸⁴

Hydrological interdependence is a key concept in international water relations. With it comes deeper relations, as cooperation in the management of shared water can bring tremendous benefits for human development on several levels including: reducing the possibility of conflict; improving the quality of shared water; achieving prosperity and securing livelihoods; and creating scope for a further cooperation in other sectors.

The countries of the European Union (EU) have achieved great improvements in freshwater standards through inter-state cooperation, leading to significant benefits for industry, human health and home users.⁸⁵

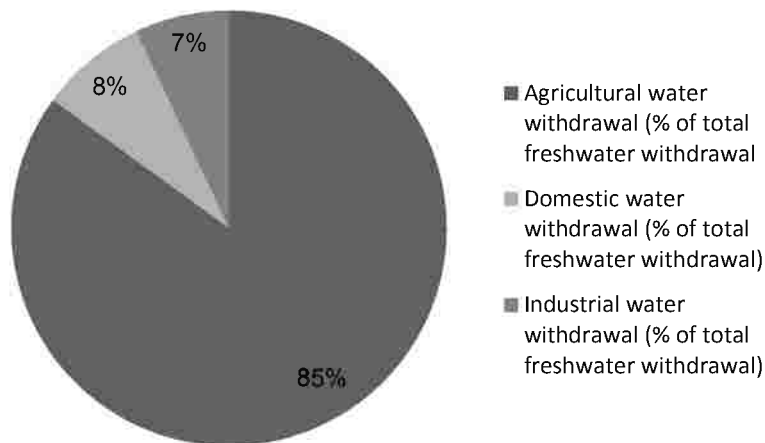
Imports, “Virtual Water” and Agriculture Abroad

All countries seek to achieve food and water security, and to provide for the requirements of their peoples without over-exploiting their natural water sources. The pattern of fresh water demand in the Arab Gulf region shows that with population growth water demand increases in all sectors: agricultural, industrial and domestic. However, agriculture consumes the vast majority of the water used in the region. About 80 percent of water used in the region is for agricultural use, and the remainder is divided between the industrial and domestic sectors. In the period 1965–1997, irrigated land in the region almost doubled, due in part to the fact that population growth has increased the demand for food.⁸⁶

Water demand is increasing in both the industrial and service sectors to meet the demand of a growing population. While water demand has rapidly increased in all sectors, it has grown most rapidly in households. Indeed, the domestic sector now accounts for a higher share than manufacturing in some Gulf countries, at 25 percent or more in Bahrain and Kuwait (see Figure 5.6).

Figure 5.6

Use of Withdrawn Water in Arab Countries by Sector (%), 1999–2006



Source: United Nations Development Program (UNDP), *Challenges to Human Security in the Arab Countries*, Arab Human Development Report 2009, UNDP Regional Bureau for Arab States (New York, NY: UNDP, 2009).

High standards of living and consumerism have led to higher water demand in other sectors. Rising incomes often lead to increased consumption of meat, for example, and growing meat production requires even more water and grain. Gulf governments increasingly rely on food imports to feed populations that are growing faster than the pace of food production.⁸⁷

To deal with the water–food dilemma, the Arab Gulf states import food from countries rich in water resources—which essentially represents “virtual” water, i.e., “water used elsewhere to produce foods that are exported to water-scarce areas.”⁸⁸

To this end, the Gulf states have also adopted a policy through which agricultural and arable land is purchased or leased in areas rich with water resources abroad—particularly Africa. This policy will allow the Gulf states to produce resources abroad, rather than just import them from abroad.

Regional Water Supply Management Policies

Purchasing Water from Abroad

Water imports⁸⁹ grew dramatically during the last decade of the 20th century because of the continued instability of water resources in many parts of the world, particularly the Middle East.

The idea of transferring water from one country to another has existed for some time. The supply of water from Iraq (the Shatt al-Arab) to Kuwait is one of the oldest water transfer projects in the region. It began in 1909 using a ship loaded with wooden barrels full of water, in 1939 a national company was established to transport and distribute water.⁹⁰ In 1953, a pipeline project was launched to transport the water to Kuwait at a rate of 6,165 m³ per day. However, the lack of trust between the two governments prevented the completion of the project. However, it was resurrected in 1986, when a French company was commissioned by the Iraqi government to conduct a study of the project. An agreement was reached between Iraq and Kuwait in 1989 on the transfer of about 1,850 m³ per day of water from the Shatt al-Arab for irrigation, and 4,315 m³ per day from the Tigris for drinking, at an estimated cost of \$1.5 billion, but the project is yet to be implemented.⁹¹

A similar project was proposed to supply water from Iran. The idea is feasible from an economic perspective (since the distance between the Arab gulf states and Iran is very short), and might even be beneficial from a political perspective as well, as establishing such a project would help to build trust between Iran and the Gulf states.

The aim of the project was to provide Qatar with freshwater from the Karun river (in the southwest of Iran) via four 1,800 km pipelines reaching the Gulf coast, followed by another 200 km of pipelines under the sea to reach Qatar. The two countries entered into negotiations in 1989 and the estimated cost of the project was \$13 billion. Each country was to bear the cost of extending pipeline inside its territory, as Iran would also benefit from the project by meeting the water needs of some of the areas and coastal cities through which the pipeline was to pass. Negotiations continued for many years; however, it was shelved in 1999.⁹²

After the collapse of the talks with Qatar, Kuwait submitted a proposal to import drinking water from Iran. A feasibility study was prepared to discuss the various technical, economic, financial, and legal aspects of the project. The study suggested the establishment of a pipeline connecting Kuwait with a reservoir behind the Kharkha dam in the south-eastern province of Khuzestan. The proposed pipeline was 540 km in length, and would carry 300 mcm of water per annum for 30 years, with an option to double the volume to 600 mcm if needed. Iran would be paid 25¢ per cubic m³, generating revenue of up to \$75 million per year. The cost of the project was estimated at \$ 2billion. The two sides agreed in January 2003 to form a joint action committee to study the various legal, economic and technical aspects of the project. However, although the two sides signed an agreement on the project in Tehran in December 2003, neither side has ratified it, thus preventing the implementation of the project.⁹³

Lebanon adopted a similar scheme in the form of a project to transfer 750 mcm of water per year to the Arab Gulf states via a 1,500 km pipeline, whereby 400 mcm of water would be transferred directly from coastal springs and the remainder from four underground reservoirs located in inland basins. These reservoirs are artificially fed during times of abundance by spring water. The project aims to both

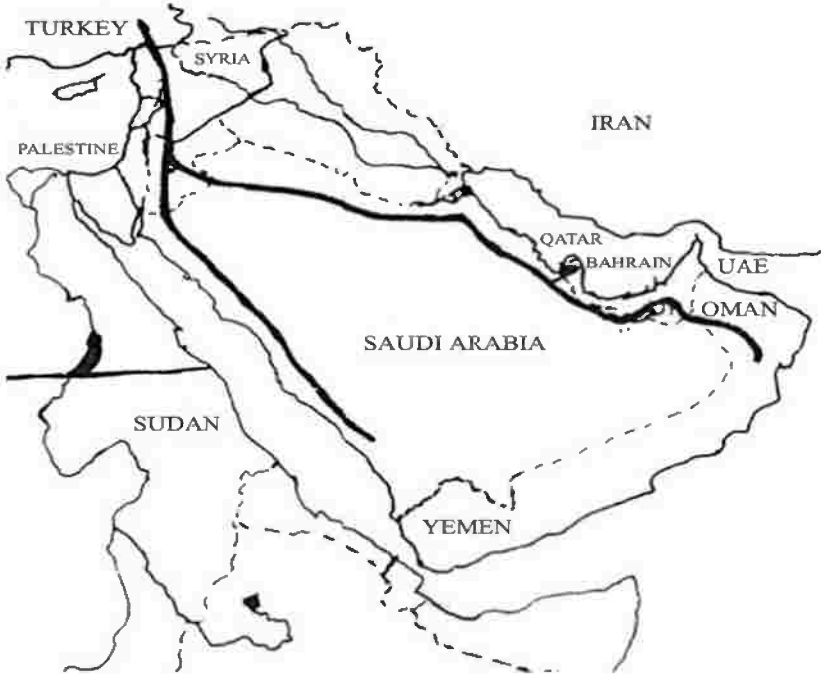
strengthen water security in the Gulf, and also to prevent the wastage of water in Lebanon that runs into the Mediterranean every year for lack of a place to store it. However, the project remained just as an idea and no practical steps have been taken to turn the project into reality.⁹⁴

One of the most useful ideas came from the Philippines, a country that for many years has been a source of cheap labor for the Gulf states, and which is too far away to pose any external threat. US and Philippine companies proposed to export water to the Gulf countries using the huge oil tankers that return empty from Japan after delivering energy supplies, and often dock in Philippines to conduct maintenance and repairs. A Filipino official described the idea as “the other side of the oil trade between Asia and the Middle East,” adding that his country could provide water from a deep aquifer to sell to the Gulf countries at a competitive price, because the transportation was already in place. The initial contract will supply 225,000 m³ of water each day for irrigation.⁹⁵

Perhaps the most well-known proposal is the “peace pipeline” project. It was suggested by Turkey, which is rich in freshwater resources, and proposed to supply Syria, Jordan and the Arab Gulf states. In 1987, the then Turkish Prime Minister Turgut Özal proposed for the first time the idea of establishing two water pipelines, stretching from Turkey to other parts of the Middle East. The peace pipeline would allow Turkey to share water from the Seyhan and Ceyhan rivers with other countries in the region. The project included the extension of two pipelines from Turkey to the region, as shown in Figure 5.7.⁹⁶

Had the project been implemented, Turkey would have achieved a number of objectives, including substantial profits (estimated at \$2 billion per year), and an expanded regional role as a stabilizing power in the Middle East.⁹⁷ Renewed interest in the project arose in the wake of the Madrid Conference in 1991, but a variety of economic and political factors prevented the project from coming to fruition.⁹⁸

Figure 5.7
The Turkish ‘Peace Pipeline’ Project



Source: Abdulaziz Shihadeh Al-Mansur, *Water Issue in Syrian Policy toward Turkey* (Beirut: Center for Arab Unity Studies, 2000), p 193.

Cloud Seeding

Cloud seeding is a technique used to increase the chances of rain by introducing a mixture of ice and frozen carbon dioxide (dry ice) or silver iodide to clouds to induce rainfall.⁹⁹

Although there have been various successful attempts in this field dating back to 1946 in the United States, there has been very little expansion in the use of this technique since.¹⁰⁰ Representatives of the Israeli water authority assert that more than 15 percent of the annual rainfall in Israel is as a result of cloud seeding.¹⁰¹ Saudi Arabia and the UAE have recently adopted the technique to increase the amount of rainfall, but the benefits obtained so far have been limited.

Icebergs as a Fresh Water Source

This technique involves transporting icebergs from polar regions (composed of pure fresh water) to areas of water scarcity, and extracting the water for storage in coastal tanks.¹⁰² As yet, this technology has yet to be implemented.

One study attempted to determine the feasibility of transporting icebergs from Antarctica to Jeddah, Saudi Arabia.¹⁰³ The study estimated the total cost of the project to be \$34 million.¹⁰⁴ However, no such project has been launched.¹⁰⁵

A review¹⁰⁶ of the costs of some alternative sources of fresh water, shows that the cost of wastewater treatment and re-use ranges from 10¢ to \$1 per cubic meter, whilst the estimated cost of transferring icebergs is between \$1.25 and 1.50, and the cost of desalination is between \$1.39 and \$2.37. According to these estimates wastewater treatment and re-use is the best option in terms of economy, particularly as it will greatly reduce wastage. Furthermore, it is clear that approaches involving cloud seeding or icebergs are far from fully developed and therefore do not present viable alternatives. Desalination and sewage treatment techniques are the approaches which guarantee an increase in water supply.¹⁰⁷

Conclusions

Contemporary, non-traditional problems such as climate change and radioactive pollution necessitate unconventional solutions and approaches. The efficiency and effectiveness of such policies may depend on the collective work of the Gulf countries to counter threats to water security in the region; this can only be achieved through the establishment of a Gulf organization for fresh water.

Owing to the vital importance of water to the region – to the extent that it has become a strategic commodity like oil – and since there is an Arab oil organization (the Organization of the Arab Petroleum Exporting Countries [OAPEC]), it is important that a similar organization be established to organize and managing water resources among the GCC countries; perhaps under the motto: “more water at a lower cost.”

Such an organization would include all the ministers responsible for water resources in the Gulf states, as well as experts and specialists from

these countries with different political, economic, environmental, technical-engineering, geographic and geological disciplines, on the grounds that this issue has become one of truly interdisciplinary significance. The organization could undertake the following tasks and functions:

- Establish a research unit to conduct water studies, or a Gulf college for water affiliated to the organization. Such an institution could develop basic frameworks and guidelines for research on the various political, economic, social, environmental and technical aspects of the issue.
- Host conferences, seminars, workshops and training courses on various water issues, providing opportunities to develop creative solutions to water concerns.
- Organize meetings and forums bringing together public officials responsible for Gulf water affairs, civil society organizations interested in water, and water users' associations, with the aim of creating a state of partnership to achieve good governance in the field.
- Determine, test and implement innovations and research that can reduce water wastage.
- Devise and maintain a unified Gulf media strategy to raise water awareness and encourage a culture of water conservation among citizens and residents of the Gulf states.

The establishment of such organization to assuming these responsibilities would enhance regional cohesion by unifying the interests of the Gulf states. The water sector could well be the sector that brings about greater political, economic and strategic integration of the Gulf states along the lines of the European Union.