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Water Issues in the Gulf: Time for Action

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Executive Summary

The limited availability of freshwater in the Arabian Gulf region has, for decades, presented a significant challenge to the people and the governments of the region. Scarce rainfall, together with a high rate of evaporation and consumption, leads to deficits in the water budgets of the countries of the Arabian Gulf region.

This Policy Brief *covers various issues related to water, such as current water status in the Arabian Gulf countries, water and agriculture, climate change and water, and water conflicts. Finally, water policy issues in the Gulf Cooperation Council (GCC) and recent initiatives are discussed.*

The Arab world, especially the Arabian Gulf countries, face many environmental threats and problems such as desertification, biodiversity loss, marine and coastal areas pollution, air pollution, and water scarcity and quality. Beside these traditional environmental threats, various other environmental problems have begun to emerge in the last few years, related to military conflicts, construction and demolition debris, and climate change.

Traditional and emerging environmental threats are all interlinked. For instance, desertification leads to biodiversity loss; livestock increase and overgrazing leads to desertification; waste-dumping releases methane, which adds to the global warming problem, in turn leading to desertification, water scarcity, and many other ecological disasters.

Natural resources are the real wealth of nations. As is well known, Gulf Cooperation Council (GCC) countries are rich in oil and gas reserves; however, they are poor in water resources and arable land. According to the United Nations, all the GCC countries except Oman fall in the category of "acute scarcity" of water. This means that these countries have an annual renewable water capacity of less than 500 cubic meters per capita. Environmental analysts say that it is closer to 100 cubic meters. It is expected that the supply of water will satisfy only 67% of demand by 2015.

THE STATUS OF WATER RESOURCES IN GCC COUNTRIES

In the GCC countries, physical water scarcity occurs because of the small amounts of annual rainfall. As a result, the region is largely dependent upon unsustainable groundwater abstractions. The average annual rainfall ranges from 70 to 130 mm, except in the mountain ranges of southwestern Saudi Arabia and southern Oman, where rainfall may reach more than 500 mm (See Figure 1). The UN Economic and Social Commission for Western Asia (UNESCWA) estimates that the average annual surface water in the region as 3,334 MCM (million cubic meters).

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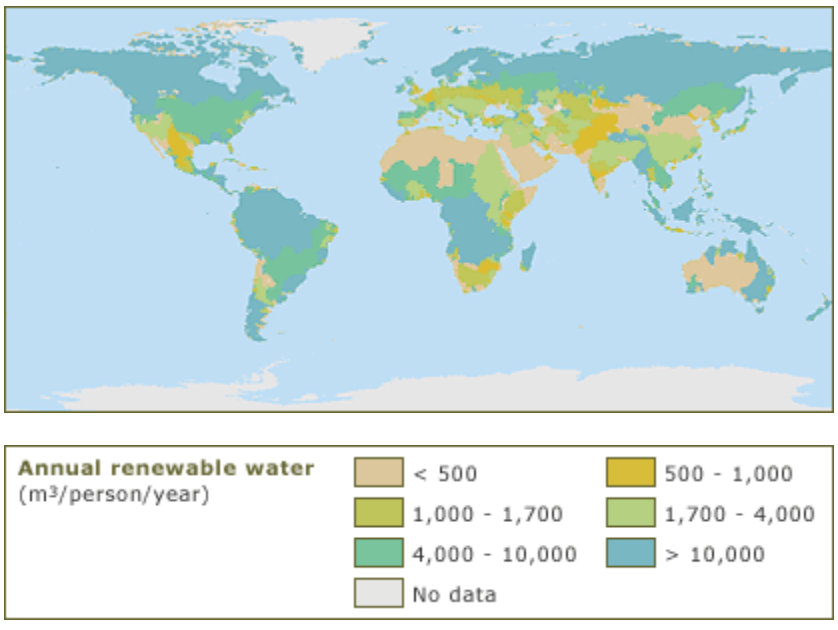
Figure 1: Annual Renewable Water



Source: World Resources Institute – August 2006

The conventional water resources of the Arabian Gulf region include surface water, groundwater, and shallow and deep aquifers. Non-conventional water resources come from desalination and wastewater recycling. While water resources are in short supply, demand for water is growing in the GCC countries. Given this situation, the question of the optimal management of water resources is clearly of crucial importance, with implications not only for the future development of these countries, but also for the sustainability of their past economic and social achievements. The dilemma arises from continuing growth in demand, which is the result of population increase and other social factors, in conjunction with the fact that the region is already exploiting all its annual surface water resources, while its aquifers are becoming depleted.

The major causes of increasing water demand include population growth and rapid urbanization, besides wasteful consumption patterns both in domestic and agriculture sectors. All the countries in the region have a high level of urbanization, more than 84% in most cases. Water consumption in these countries ranges between 300–750 liters per person per day, which ranks among the highest in the world.

In fact, importing water from various areas around the world (e.g., the Antarctic) has been suggested as a means of overcoming water scarcity in the Arabian Gulf region; however, this option poses many economic and technical difficulties. Alternative options include importing water from the Nile, Iran, Pakistan, or Turkey (the Peace Pipeline), but all of these have proven too costly and political risky.

DESALINATION

Over the last 20–30 years, most of the potable water demands have been met through desalinized water (see Table 1). GCC countries have become the forerunners in desalination technology. However, most of the existing desalination plants were built during the 1970s and 1980s and have been operated at almost their maximum capacity. It is reported that some of the plants have faced interruptions in operations, resulting in an intermittent water supply during repair periods. Furthermore, the increasing level of salt concentration in the Gulf region — owing to large amounts of highly saline brines discharged from desalination plants — could render the operation of desalination plants more costly and challenging in the future.[1] Also, any chemicals added to the desalination process for scale prevention, corrosion reduction, and corrosion products might also be discharged into water bodies. Likewise, inland brackish water desalination plants also can face major challenges in disposing of brine discharges in a safe manner and incur heavy treatment costs.

Table 1: Desalination Water Supply Share in 1990 and 2005

Country	1990			2005		
	Desalination Production (mcm)	Domestic Demand (mcm)	Desalination to Demand ratio (%)	Desalination Production (mcm)	Domestic Demand (mcm)	Desalination to Demand ratio (%)
Bahrain	56	103	54	122.7	133	92
Kuwait	240	303	80	589.1	610	96.5
Oman	32	86	37	67.932	170	40
Qatar	83	85	98	250.13	252	99
Saudi Arabia	795	1,700	47	1,063.28	2,458	43
UAE	342	540	63	812.61	951	85
Total	**1,548**	**2,817**	**55**	**2,905.75**	**4,574**	**63.5**

Source: Mohamed A. Dawoud, "Water Scarcity in GCC Countries: Challenges and opportunities," Gulf Research Center, Dubai, 2007.

1. World Bank,"A Water Sector Assessment Report on the Countries of the Cooperation Council of the Arab States of the Gulf," Environment, Social and Rural Development Department, Middle East and North Africa Region, Report No. 32539-MNA, 2005.

GROUNDWATER

In the Gulf region, shallow groundwater aquifers, located along the main *wadi* (valley) channels and the floodplains of drainage basins, are the only renewable water resource. Large, deep aquifers are present in the region; they contain non-renewable supplies of fossil water and have a finite life and quality limitations. Only Saudi Arabia possesses substantial amounts of non-renewable groundwater in deep aquifers. However, even these are being rapidly depleted.

There are two major aquifers: the Kuwait group (upper layer) and the Dammam group (lower layer). Bahrain receives groundwater by lateral under-flow from the Dammam aquifer, which forms only a part of the extensive regional aquifer system, called the Eastern Arabian Aquifer. This aquifer extends from central Saudi Arabia, where its main recharge area is located at about 300 meters above sea level, to eastern Saudi Arabia and Bahrain, which are considered the discharge areas.

Very few studies on underground water have been conducted, and cooperation between GCC countries on utilizing and the managing such joint aquifers is negligible. This is very risky, because if the water situation in the region worsens, countries will turn to the unilateral use of such aquifers, which may lead to conflict.

In all GCC countries, since the amount of groundwater abstraction is far greater than the amount of recharge, aquifer levels have rapidly depleted, and the groundwater's salinity has increased. The excessive use of groundwater has resulted in sharp declines in groundwater levels, which in some aquifers dropped more than 200m during the last two decades. Many springs and shallow aquifers have dried up. Higher pumping in the eastern parts of Saudi Arabia and Bahrain also has disturbed the dynamic equilibrium between aquifers, leading to the leakage of poor quality water from one aquifer to another.

Groundwater pollution is caused by several factors. The most important factor is over-pumping from wells. Other factors include seawater intrusion, irrigation returns, the heavy application of chemicals, high evaporation rates, and liquid effluents from septic tanks. Many water wells in Bahrain, Qatar, the United Arab Emirates, and Oman have been abandoned as a result of seawater intrusion.[2] In all cases, GCC countries should start to estimate accurately the underground water reserve and work toward the balancing of such reserve through identifying the annual withdrawals needs.

WASTEWATER RECYCLING

Wastewater treatment in the Gulf region constitutes an increasing water source, due to escalating water consumption in urban areas. The treated wastewater is used mainly for irrigating fodder crops, gardens, highway landscapes, and parks.

WATER AND AGRICULTURE

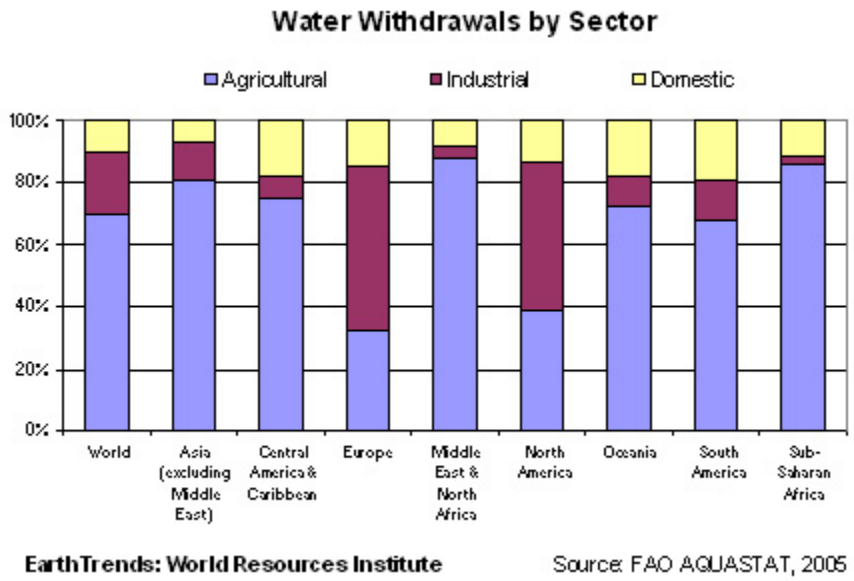
Until recently, water management policies concentrated on the supply side. Driven by the optimistic agricultural policy of achieving food self-sufficiency, the governments of the GCC countries directed water development projects towards the continuously expanding agriculture sector. In addition, economic incentives in the form of subsidies helped in boosting agricultural production, and consequently put more stress on the available water resources. Lacking necessary planning and future insights has led to the consumption of fossil (non-renewable) groundwater aquifers as demands exceeded the renewable water resources. During the past few years, these countries have begun to change their water management and food security policies, but additional measures are needed.

It is worth mentioning here that, despite a meager contribution to GDP, agriculture continues to be the prime water-consuming sector. In fact, agricultural water use has increased from about 73.5 billion cubic meter (BCM) in

2. Hashim and Abdulmalik, "Water-related Ecological Hazards and their Mitigation in Qatar," pp. 903-915, *Water in GCC — Towards an integrated management, conference proceedings — Vol. II, State of Kuwait*, November 19-23, 2005.

1990 to over 90 BCM in 2000, exerting immense pressure on the limited water resources in the region. Food self-sufficiency, which has been adopted as a policy, imposes constraints on the allocation of water resources, and prevents its diversion from the agricultural sector to the domestic or industrial sectors. (See Figure 2)

Figure 2



Agriculture accounted for just 3.3% of the UAE's GDP, less than 1% of Kuwait's, and about 6.5% of Saudi Arabia's. However, agriculture continues to be the prime water-consuming sector in the GCC. The policy of food self-sufficiency imposes constraints on the allocation of water resources and prevents its diversion from the agricultural sector to the domestic or industrial sectors. However, it may be pointed out that there is little scope for expansion in the agriculture sector in the GCC region. Table 2 gives the water allocation trend and projection of three major sectors in the GCC countries.

Table 2: Current and Projected Sectoral Water Use Changes in GCC Countries (in MCM)

	1995			2000			2025		
Country	Domestic	Agriculture	Industrial	Domestic	Agriculture	Industrial	Domestic	Agriculture	Industrial
Bahrain	86	120	17	118	124	26	169	271	169
Kuwait	295	80	8	375	110	105	1,100	140	160
Oman	75	1,150	5	151	1,270	85	630	1,500	350
Qatar	76	109	9	1,990	185	15	230	205	50
Saudi Arabia	1,508	14,600	192	2,350	15,000	415	6,450	16,300	1,450
Emirates	513	950	27	750	1,400	30	1,100	2050	50
Total	**2,553**	**17,009**	**258**	**3,833**	**18,089**	**676**	**9,679**	**20,466**	**2,229**

Source: Dawoud, "Water Scarcity in GCC Countries."

In this regard, the concept of "virtual water" also holds immense relevance for the water-scarce countries. By as-

sessing how much water can be saved through importing certain food items (particularly those that consume high amounts of water such as fodder or alfalfa for dairy production), and other products such as wheat, a huge amount of water can be saved and appropriately utilized. 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 other purposes." Analysis of "virtual water" should be included in development plans as a means of relieving pressure on the scarce water resources of GCC states. For example, Oman estimated that "virtual water" imports into the country in 1998 were approximately 3,860 MCM, which represents about three times the total annual replenishment of the natural water resources of the country.

This provides strong insights as to how much water could be saved by importing food and possibly shifting the saved water to other economic purposes or conservation for future generations.

Irrigation water is generally used in a wasteful manner, mainly through traditional flooding and furrow irrigation techniques and for cultivating low value, highwater-consumptive crops, without considering the economic opportunity costs...

Without a doubt, the food self-sufficiency policies adopted by GCC countries do not appear to have been successful and are not sustainable. Since no clear target for food security was established, it is difficult to substantiate or refute the claim that these policies have been successful; moreover, success has come at a very high cost. In any event, the GCC countries do not have the renewable water resources and arable land for these policies to be sustainable.

It is worth mentioning that many companies and environmental non-governmental organizations (NGOs) across the region recently have embraced programs for greening deserts through campaigns of indigenous species planting projects. This is an unwise solution in water-scarce countries, even if indigenous species are being planted. The GCC has to accept and adapt to its surrounding ecosystem, which is a desert area with scattered indigenous species. Expanding the planting of indigenous species has its limits and should depend upon carrying capacity studies. The GCC could better focus on plans, programs, and projects which fight desertification and conserve the green areas the region already has. In fact, preserving natural ecosystems is essential to the future availability of fresh water in the region.

In addition, irrigation water is generally used in a wasteful manner, mainly through traditional flooding and furrow irrigation techniques and for cultivating low value, highwater-consumptive crops, without considering the economic opportunity costs for potable and urban/industrial purposes. In this predominantly desert region, losses can exceed 50% of pumped groundwater.[3]

WATER AND CLIMATE CHANGE

Everyone seems to agree that climate change has brought about changes in sea levels and the weather. It is also commonly believed that conflicts in areas like Darfur are often over a combination of factors such as ethnic differences and resource scarcity. However, it is not often that we draw the links between the global phenomena of extreme weather or acute variations in rainfall to civil strife in Africa and other arid regions. Climate change has made itself prominent as an aspect of national security in recent years, and a water-scarce region like the Arab Gulf states would find it unwise to neglect climate change in policy decision-making.

Water is a source of life and is at the heart of the problem of climate change — glacier melt, rising sea levels, drought, and desertification are all water-related issues. Historically, civilizations rise near the banks of major rivers and are heavily dependent on them for water, agriculture, transportation and trade. Water always has been both a

3. World Bank, "A Water Sector Assessment Report on the Countries of the Cooperation Council of the Arab States of the Gulf."

blessing and a source of conflict. In fact, the English word "rivalry," derived from the Latin "rivalis," basically means "one using the same river as another."[4] Water is also inextricably linked to the health of a population — fresh water is required for consumption, sanitation, and the irrigation of cropland. It has a direct influence on agriculture, which in turn affects harvests and people's livelihoods, particularly in subsistence farming areas.

Besides factors such as increased human demand for groundwater due to erratic rainfall patterns and reduced surface water flows in the summer in snow-dominated basins, rising sea levels also will have an impact on groundwater recharge rates. Changes in saltwater levels could result in saltwater intrusion into aquifers, rendering the groundwater un-potable. Water quality will be affected by higher surface water temperatures, which promote algal blooms and increase bacteria and fungi content, creating a bad odor and taste in chlorinated drinking water.[5]

It is hardly surprising to note that some of the most parched regions of the world also suffer from perennial unrest. Although superficially it seems that extrinsic factors like rising food prices are the reason for the tensions among people, the root of the problem is often the dependence of agriculture on a scarce water supply.

It will be wise to seize upon the chance of making use of the Adaptation Fund that became available following the Bali negotiations in December 2007. One of the significant outcomes of the negotiations was the decision to operationalize the Adaptation Fund, which was set up to finance adaptation in developing countries. The fund will help execute projects that fight desertification, climate change, and water issues.

WATER CONFLICTS

Although seldom the trigger for wars, the thirst and desperation created by water shortage or a threatened water supply adds fuel to existing tensions between peoples. The most reported violence over water resources is probably the simmering conflict between black farmers and Arab nomads in Darfur, Sudan. Drought and desertification in the northern parts of Darfur has led to the migration of Arab nomads to the south of Darfur, where they came into contact with black African farmers and started disputes over land and water resources. This is just one among many cases wherein through deeper investigations of such conflicts it becomes clear that what seems to be a dispute caused by an ethnic divide in fact has its roots in water resource distribution.

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The conflict in Darfur is by no means an isolated example. Appendix 1 uses past water conflicts to illustrate the severe consequences that can arise from threats to water resources. "Genuine water scarcity" refers to situations where there is a real natural shortage of water in the region and is not due to the restriction or control of water sources. "Water used as a political tool" refers to the control or closing of water sources for extortion or as a threat by neighboring states, even when water is abundant in the region.

The importance of water to survival is shown clearly in the above examples. Historically, warring states made use of existing water resources to threaten the opposing country by poisoning wells or controlling access to water supplies that were not necessarily scarce. However, recent conflicts over water are triggered by a genuine shortage more than by inaccessibility. This is a worrying sign, as it is no longer a situation of territorial dispute and ownership; the control

4. J. Tulloch, "Water Conflicts: Fight or Flight?" *Allianz Knowledge*, March 19, 2008, http://knowledge.allianz.com/en/globalissues/climate_change/natural_disasters/water_conflicts.html.

5. Z.W. Kundzewicz, L.J. Mata, N.W. Arnell, P. Döll, P. Kabat, B. Jiménez, K.A. Miller, T. Oki, Z. Sen and I.A. Shiklomanov, "Freshwater resources and their management," in M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds., *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge, UK: Cambridge University Press, 2007), pp. 173-210.

of the circumstances is no longer in the hands of the warring states. This problem is now massive — and one that calls for global responsibility and responsiveness.

The compelling evidence of climate change and its toll on freshwater resources makes every country responsible for water shortages the world over. This complicates matters when it comes to reaching a consensus as to how much each of us should do in order to mitigate the problem. First, it is difficult to see from the point of view of a single person or country what difference we can make by reducing carbon emissions or recycling products. Second, it is much easier to be indifferent to the plight of others and remain passive about the situation. Third, it is hard to be convinced of the necessity of action when the effects of climate change have not hit us hard enough. This complacency will cost us dearly if we only decide to react when it is too late.

Water has implicitly become part of basic human rights. Accordingly, to be wasteful, to deprive others of an essential element of survival, or to use water as a military/political tool has become increasingly unacceptable. Major polluters of the atmosphere may not initially seem to be taking away this basic right, but their prolonged contamination of the Earth makes them guilty of the same crime. It is thus important to embark upon a collective effort from every region to reduce the effects of climate change through international cooperation as indirect perpetrators of today's water conflicts. The only question remaining is: Why isn't more being done?

Ignorance is always a convenient excuse for inaction. However, the existence of international conventions and treaties on various environmental issues give states no excuse for being oblivious to the situation. Being aware of the problems and the need for a concrete plan, it is up to these leaders to facilitate nationwide understanding of environmental issues in their home countries so that environmental policies are effectively implemented.

WATER POLICY

Policymakers have now shifted from entirely supply solutions to demand management, highlighting the importance of using a combination of measures to ensure adequate supplies of water for different sectors. These include the reduction of fuel and agricultural subsidies, the metering of groundwater wells, future plans for an irrigation water tariff, subsidies for modern irrigation techniques, and public awareness campaigns. In the GCC countries, the "GCC Water Cooperation Committee" was established in 2002 to enhance water management at sub-regional level. The committee's main agenda items are: first, integration and harmonization of the water sector; and second, coordination of research and development in desalination, such as helping to reduce the unit production costs of desalination and treatment.

In most Arabian Gulf countries, effective national institution frameworks have been set up to meet the demand for water resources management. All the countries of the region have developed national water plans keeping within the broad lines of Agenda 21.

The decentralization of water, the establishment and maintenance of water databanks, and participatory approaches to dealing with the water sector have emerged in some countries. The best example of this is the system of *aflaj,* a system of conveying water from its source through sloping, open channels to irrigation points (with user associations determining water allocations in Oman, UAE, Yemen, and Saudi Arabia).

RESIDENTIAL

	Consumption/Month	Slab Tariff
G	0 - 6,000	3 fils/Gallon
Y	6,001 - 12,000	3.5 fils/Gallon
O	12,001 & Above	4 fils/Gallon

INDUSTRIAL & COMMERCIAL

	Consumption/Month	Slab Tariff
G	0 - 10,000	3 fils/Gallon
Y	10,001 - 20,000	3.5 fils/Gallon
O	20,001 & Above	4 fils/Gallon

The governments need to act immediately in order to secure water needs in the short, medium, and long term for different sectors by using different policy options, technologies, and even political pressure, as well as deals that can secure water supplies from friendly countries.

It is worth mentioning that one of the recent initiatives is the new tariff system in-

troduced in March 2008 by Dubai Electricity and Water Authority (DEWA). Rising tariffs are likely to make people more conscious of using water efficiently, encouraging customers who fall into the higher categories of consumption to cut back on use. Under the Slab Tariff System, residents using up to 2,000 kilowatts of electricity and up to 6,000 gallons of water will pay a charge of 20 fils per kilowatt and three fils per gallon of water used. Those using over 6,001 kilowatts of electricity and more than 12,001 gallons of water will be charged an additional 33 fils and four fils per unit respectively.

One must admit that this is a step in the right direction and sends signals to consumers about the true cost of water. However, the new tariff does not apply to UAE nationals. In fact, it would be better to offer them a monetary allowance and charge their wasteful water consumption instead according to the new DEWA tariff. From the environmental point of view, this is more environment-friendly.

An increasing block rate, unlike other policy tools such as a flat rate or a decreasing block rate, is one of the best cost recovery options, as it sets a volumetric rate that increases according to higher use levels and thus economizes water use.

Recently, many have recommended "water pricing" as the best solution. However, this market-based approach is ill-suited to developing countries, whose governments must guarantee a "lifeline" that provides for the basic needs of people, many of whom have meager financial resources. How can they be asked to pay for water?

It might be accepted to have some sort of cost recovery program in GCC countries. Besides, there is an urgent need to send some signals to customers, especially those with high living standards and high consumption patterns, about the importance of conservation. However, this varies from country to country and over time, depending on various economic, political, and social considerations.

There is an urgent need to send some signals to customers, especially those with high living standards and high consumption patterns, about the importance of conservation.

The appropriate cost recovery program in the water sector promotes resource conservation by encouraging the efficient use of water and facilitates cost recovery. Water tariffs must conform to a set of conditions, of which the most important is that they are affordable for all, that they are acceptable to the population, and that they are administratively and institutionally feasible.

Further, there are a number of priorities in relation to water policy that could be adopted by policymakers for maintaining water resources:

The regional approach: Regional cooperation and joint projects will ensure that the possible consequences of water policies are anticipated and examined and water issues are included in countries' interests.

The reliance on desalinated water alone could be a risky policy, considering the volatile nature of oil prices and revenues — which largely fund the process — and various negative environmental impacts. However, there is no doubt that desalination is an important component in the water budget of GCC countries. The sustainable use of groundwater resources should be a consideration in the overall integrated water resource management policy of each country. More research should be devoted for cutting down costs and obtaining new environment-friendly desalination technologies.

Aflaj: Most of what is traditional is more environment-friendly. Therefore, it is important to protect traditional systems like *aflaj*.

Water Quality is of importance too. If water quality continues to deteriorate, then it will be unsuitable for many

purposes and total freshwater supplies will decline.

Rationalizing government subsidies: One of the primary reasons for the unsustainable exploitation of groundwater resources has been the provision of direct and indirect subsidies to well excavation, pumps, fuel, and other inputs as well as price support programs and trade protection in some GCC countries.

Policy mix: Experience has shown that specific environmental issues such as water problems are usually addressed by employing a "policy mix," consisting of various command and control instruments (penalties and fines), economic instruments (incentives), and awareness and educational programs. This policy mix needs to address different water issues; additionally, a more active role should be assigned for civil society organizations in water related decision-making and a greater role should be given to the private sector to invest in water projects.

Agricultural subsidies for wells, fuel, and other inputs, price support programs and trade protection in some countries could be removed; controls on groundwater extraction could be made more stringent; and charges could be increased for irrigation that contributes to the depletion of aquifers. In recent decades, the net irrigated areas have increased in all GCC countries by 100 to 300%. It is worth noting that in Saudi Arabia, the rapid expansion of irrigation areas due to generous subsidies led to nearly tripling the volume of water from around 7.4 BCM in 1980 to 20.3 BCM in 1994, before falling to 18.3 BCM in 1999.[6]

Water has an economic value; first we secure the human needs for safe, potable water and then we should use and allocate water in sectors that maximize the economic return.

INTEGRATED WATER RESOURCES MANAGEMENT

The Integrated Water Resources Management (IWRM) concept, announced in the 1990s and again articulated at the Third World Water Forum in Kyoto 2003, is being transformed into action on the ground through development and implementation of sound water management policies and practices which focus in particular on:

- A broad-based water demand management policy.
- A comprehensive program for reducing groundwater extractions and achieving more sustainable aquifer management.
- A comprehensive program for non-conventional water resources, including desalinated water, reclaimed wastewater, brackish water, and water importation.
- Institutional arrangements and coordination.
- An increased role for the private sector.

The water sector needs to be integrated into an overall plan, encompassing groundwater, desalinated water, and treated wastewater in order to optimize the use of each resource for the highest economic and social benefit of each country. While it can be concluded that, with the exception of Oman, a significant proportion of future water supplies for both potable and industrial water will be derived from the desalination of both brackish and sea water, an IWRM program covering demand management, institutional and legal aspects, a greater role for the private sector, and new sources of supply is needed to ensure that water resources are used most efficiently and sustainably.

From the policy side, it is crucial to adopt the IWRM, which is a multi-user participatory systematic process for sustainable development, allocation, and monitoring of water resources use in the context of social, economic, and

6. World Bank, "A Water Sector Assessment Report on the Countries of the Cooperation Council of the Arab States of the Gulf."

environmental objectives.

IWRM governance aims to enable an environment of appropriate policies and strategies and to foster the enactment of adequate legislation and the establishment of an institutional framework and management instruments. IWRM is a voice for addressing water allocation, pollution control, and wastewater management problems in a manner that seeks to preserve the environment and protect human health.

POLICY OBSTACLES

There are many policy obstacles. The *lack of data* is foremost among them. In order to conduct a systematic assessment of the state of water resources in the region and to construct future scenarios, the development and monitoring of certain datasets is of prime importance. An indicative list of this would include:

- Time series climatological/meteorological data such as rainfall data for at least 30 years
- Time series data of the status of groundwater aquifers and quality
- Water quality monitoring of all sources of water, including the non-conventional sources such as treated sewage effluent being used in horticulture
- Monitoring of sectoral demands, supply and consumption patterns. For example, for the agriculture sector information on total irrigated area, cropping pattern, irrigation methods used, etc. is required
- Considering the extent of urbanization in the Gulf states, the extent of infrastructure provisions such as water and wastewater treatment facilities, water supply, and sanitation coverage is also an important data set
- Information on tariff structures, subsidies, and cost of water production and treatment
- Time series data on the status of health in order to study the impact of initiatives such as improved water supply and sewerage coverage

These datasets are also important for conducting impact assessment studies, which are crucial for undertaking projects such as wastewater recycling and reuse and artificial groundwater recharge.

A second important obstacle is *the lack of institutional arrangements*. Sustainable water resource management depends on the role played by institutions, their impact on people, people's confidence in them, and their transparency. The development of separate ministries for water resources that are responsible for water resource management and planning would result in:

- Development of specialization and concentration of expertise on water-related matters within a single institution;
- A separate ministry serves in itself to reflect the government's concern for water issues;
- Equal status in dealings with other sectoral ministries.

In some GCC countries, the responsibility for the administration, regulation, and development of water supplies is rather fragmented between many government entities. In contrast, Oman and recently Saudi Arabia have embarked on institutional reforms for integrated water resources management. Fragmented arrangements frequently result in conflicting policies, political competition between agencies, and the lack of a comprehensive and coordinated policy for the allocation, management, and use of water supplies, which needs to be addressed on a priority basis. Building human cadres in various aspects in the water sector is also an obstacle which needs to be overcome as soon as possible. Nothing can be achieved if there are not managerial and technical local experts in the water sector. Of course all these aspects require an updated regulation in the water sector and effective enforcement.

A third key obstacle is *ingrained habits*. Changing people's habits and the ways they use water is a challenge that involves changing deep-rooted attitudes held by individuals, institutions, water professionals and civil society organizations. This can be brought about by enhancing the educational curricula on water related issues, the regular training of water professionals, and communication with stakeholders and water campaigns.

CONCLUSION

According to various scientists and scientific research centers around the world, the amount of the water in the world — which has been a constant since the world was created — is enough for all living creatures on the earth. The problem lies in mankind's misuse and mismanagement of this valuable resource. The main problem lies in the *value system* that governs the usage and management of natural resources nowadays, rather than being a technical or engineering challenge. The current value system is mainly driven by economic benefits without taking into consideration social and environmental sustainability, which are at the core of Islamic values. These values require that man serve as a custodian of the earth by preserving resources and only developing communities that maximize positive impacts and avoid or eliminate negative impacts.

Needless to say, in Arab Islamic societies such as the GCC, efforts to increase awareness and find solutions to water scarcity should have been easy because of religious reasons, as many Qur'anic verses encourage the preservation of water, a precious commodity, even during the mandatory *wodhu'* or ablution before prayers. The use of religious guidelines must be an integral part of any awareness campaign.

GCC countries need to enhance water harvesting and storage measures; improve monitoring to develop a sound analytical base for policymaking; focus on human-induced climate change; and expand studies on groundwater as an adaptation strategy. GCC countries should also pursue opportunities for community-owned infrastructure.

The water issue is a crucial issue for the future of the people of the GCC countries. There is a need to store water for future generations' use of natural depleted wells and aquifers. There is an urgent need to prioritize water uses and sensible usage especially in agriculture. Agriculture policy requires a total rethinking. Some recent trends point towards this necessity. Organic agriculture, which is the recent trend in the GCC, is much better than heavy chemical agriculture. Greenhouse agriculture methods may be of some importance to GCC countries as a replacement for traditional, heavy water-consuming practices.

There is a need to look for alternatives to water in various uses, such as the recent initiative by ENOC Petroleum Company in Dubai to use some safe chemical materials to wash cars.

Finally, the GCC should recognize that there is no one solution that fits the entirety of the problem. Every country may need to shape its management system to fit its specific needs. Policy measures must be tailored not simply to each state's needs, but to those of each municipality and region, whose perceived problems and priorities are unlikely to be identical.

Appendix

Table 1: Conflicts Caused by Water Shortage

I. CAUSED BY GENUINE WATER SCARCITY IN REGION		
Date	Parties involved	Description
1947-1960s	India, Pakistan	Partition leaves Indus basin divided between India and Pakistan; disputes over irrigation water ensue, during which India stems flow of water into irrigation canals in Pakistan.
1951, 1953	Israel, Jordan, Syria	1951 - Jordan makes public its plans to irrigate the Jordan Valley by tapping the Yarmouk River; Israel responds by commencing drainage of the Huleh swamps located in the demilitarized zone between Israel and Syria; border skirmishes ensue between Israel and Syria. 1953 - Israel begins construction of its National Water Carrier to transfer water from the north of the Sea of Galilee out of the Jordan basin to the Negev Desert for irrigation. Syrian military actions along the border and international disapproval lead Israel to move its intake to the Sea of Galilee.
2000	China	Civil unrest erupted over the use and allocation of water from Baiyandian Lake, the largest natural lake in northern China.
2004-2006	Ethiopia, Somalia	At least 250 people were killed and many more injured in clashes over water wells and pastoral lands. A three-year drought led to extensive violence over limited water resources, worsened by the lack of effective government and central planning.
2007	Burkina Faso, Ghana, Cote D'Ivoire	Declining rainfall led to growing fights between animal herders and farmers with competing needs. In August 2000 people were forced to flee their homes by fighting in Zounweogo province.
II. CAUSED BY USE OF WATER AS A POLITICAL TOOL		
Date	Parties involved	Description
1978 - onwards	Egypt, Ethiopia	Long standing tensions over the Nile, especially the Blue Nile, originating in Ethiopia: Ethiopia's proposed construction of dams in the headwaters of the Blue Nile leads Egypt to repeatedly declare the vital importance of water. In 1979, Anwar Sadat declared that, "The only matter that could take Egypt to war again is water."
1992	Czechoslovakia, Hungary	Hungary abrogates a 1977 treaty with the Czech Republic concerning the construction of the Gabcikovo/Nagymaros project because of environmental concerns. Slovakia continues construction unilaterally, completes the dam, and diverts the Danube into a canal inside Slovakia. Massive public protest and movement of military to the border ensue; issue taken to the International Court of Justice.
1997	Singapore, Malaysia	Malaysia supplies about half of Singapore's water and in 1997 threatened to cut off that supply in retribution for criticisms by Singapore of its policy in Malaysia.
2000	Kyrgyzstan, Kazakhstan, Uzbekistan	Kyrgyzstan cuts off water to Kazakhstan until coal is delivered; Uzbekistan cut off water to Kazakhstan for non-payment of debt.

Selected Water Conflicts adapted from "Water Conflict Chronology" by Gleick, P H of the Pacific Institute for Studies in Development, Environment and Security.