

Sustainable Water Resources Management in Arid Environment: The Case of Arabian Gulf

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Abstract

Over the past decades the Arabian Gulf region has witnessed a great economic development and social transformation. The region is facing a water insufficiency problem that is one of the biggest in the world. The level of available renewable water in the region is one fifth of what the rest of the world enjoys on a per capita basis. The population of the region is growing 55% more quickly than the population at the rest of the world. By 2020, water needs is predicted to be around 341 million imperial gallons per day. The threat of water scarcity ensures that investment in developing freshwater supply, along with the recycling and reuse of waste and sea water is an urgent priority across the region moreover strategies for sustainable water use have to be adopted. This means that if strategies for rational water use that entail educational component is not established the water storage is going to run out. This paper reviews the existing situation identifies the gap and proposes an appropriate institutional framework which involves assignment of responsibilities among various levels. Ensures stakeholders participation, accommodates adaptive change and remain self sustainable.

Keywords: Arabian Gulf ; Water scarcity; Sustainable management; Arid environment

Introduction

The availability of adequate freshwater has become a limiting factor of the quality of life, worldwide. More than availability, the problem is often the rational use of water than ensure its continuity. In the semi-arid and arid regions water scarcity was always a dominant problem moreover, the interference with the natural hydrologic cycle as a result of overexploitation of both surface and ground waters and of changes in land usage resulted not only in the reduction of the available water amounts but also in the deterioration of the water quality due to pollution from urban, industrial and agricultural practices and salinity build-up in soil and water. Such a situation is in all cases a pretext for discord and assignment of blame on those supposedly responsible for the deterioration of the water accessibility, especially in view of the possible high cost and technical complexity of the measures that need to be taken for remedying and alleviating the situation. Arabian Gulf countries are located in an arid area with limited water resources [1]. Hydrological investigations point to limited resources of underground water. The best choice for providing fresh water in the Arabian Gulf countries is through seawater desalination with ground water as a backup. About 65% of desalination plants that are in operation worldwide are located in the Arabian Gulf countries, most of which are the dual-purpose multistage flash (MSF) plants, producing power and water. Integrated water resource management (IWRM) is the need to take a holistic approach to ensure the socio-cultural, technical, economic and environmental factors are taken into account in the equitable development and management of water resources.

Sustainable and Integrated Water Resources Management

The relationship between "Sustainable" and "Integrated" Water Resources Management is essentially that sustainability is the general goal whereas Integrated Water Resources Management (IWRM) is a strategy for pursuing this goal. Water is a resource under considerable pressure. Effective and sustainable management of water resources is vital for ensuring sustainable development [2]. However, efforts of water resource management seem to demonstrate inappropriate practices, especially when compared to water consumption trends in Arabian Gulf states. Being a major and vital ingredient to human kind, water resources influence all sectors. However, there have been increased problems over time that subject water resources to a number of crisis and pressures. Poor water resources management have stimulated and sustained a number of problems related to health, socio-economic and environment, which need to be solved. Integrated water resources management (IWRM), is a process, a change, and an approach that mainstream water resource use and management into the national economic in an equitable manner without compromising the sustainability of vital ecosystems. Successful community involvement demonstrates the importance of IWRM. Public/community involvement is crucial for a successful and sustainable water resource management. It has been emphasized that natural resources management related policies including water requires the use of knowledge, experience and opinions of local communities who are the key stakeholders in resource conservation.

Water Resources of the Region

In the area under discussion the arid climate extending over the Gulf States is characterized by large geographic and temporal disparities of the precipitation distribution, with relatively more annual amounts of precipitation in winter season, a relatively variable

regime, with alternating drought and excessive rain periods further acerbates the situation. Scarcity of water resources in the region is evident some studies earlier this year said that the imminent shortage of water resources in the region has been compounded by the real estate boom, with new construction projects taking a larger share of resources. This is alarming since this region is already the driest in the world. The Gulf remains the largest market for water desalination in the world and local municipalities are seriously examining ways to double existing capacity to meet regional demand [3].

The arid climate of the region where rainfall is sparse, limits conventional water resources and recent studies show that temperatures are increasing. In August 2009, a temperature in some areas of the region has exceeded 47.3°C. The available water resources in the Arabian Gulf countries are mainly the ground water which is not enough to satisfy the water demand due to the rapid urban and industrial developments. Due to the improper planning and mismanagement of the water abstraction from the wells, the ground water is very much reduced and in many countries the withdrawal of water is now done from the non renewable layers. Abstracting water from the non-renewable layer causes a serious problem because this layer was formed during very long decades and abstraction from this layer will definitely deteriorate the ground water storage. Desalination of seawater is one of the main alternatives for the substitution of water shortage in the Arabian Gulf countries and other countries. Although desalinating the seawater is costly, it is still an important option for compensating for the water shortage. Most of Gulf countries built power and desalination plants for water and power production. We should be aware of the fact that the effluent discharges from the plant back to the sea may have a negative impact on environment.

The Gulf remains the largest market for water desalination in the world and local municipalities are seriously examining ways of looking to double existing capacity to meet regional demand. However, it is North Africa that will experience the greatest growth in desalination, Algeria and Libya experiencing a 300 per cent growth. Water desalination, specifically membrane processes based on reverse osmosis, is becoming more efficient as more technologically advanced methods are being developed. The price of desalinating one cubic meter of water has come down more than a third of what it used to be 10 years ago.

	2001	2002	2004	2007	2010
UAE	165.1	182.4	204.9	229.1	229.1
Bahrain	27.9	29.8	30.4	32.1	33.87
KAS	293.14	214.98	233.99	270.46	275.14
Oman	20.79	21.54	22.72	23.98	26.19
Qatar	32.3	33.5	34.8	35.6	35.6
Kuwait	82.134	107.27	90.89	95.17	97.87
Total	621.364	589.49	617.7	686.41	697.77

Table 1: Water production in Gulf States.

Water Resources Deficiency

The problem of water shortages in the Gulf States is quite evident despite the fact that these countries adopting advanced technology. Water scarcity in the region is rapidly becoming part of a widespread

environmental concern for the region. water deficit in the Arab Gulf countries is estimated to be 16 billion cubic meters, this would have an impact on the quality of ground water. Consumption per capita, which is currently at 1,100 cubic meters annually, is projected to fall to 550 cubic meters a year by 2050. While Gulf countries spend around \$133bn in water and wastewater management yearly, more effective strategies are needed, such as convincing companies and even residents to set up their own sustainable infrastructure.

The region has the lowest availability of actual renewable water resources per capita in the world. It is thus imperative that gulf governments invest in technologies that can ensure adequate supply for the region's vibrant industries and its more than 300 million inhabitants [4].

Building and industrial projects alone in the region will consume more than 112 billion liters of drinkable water from 2008 to 2009 this part of the world hosts 5% of the global population and yet possesses only 1% of the world's renewable fresh water. Desalination is likely to become one of the world's biggest industries. Growing communities and new industries must have dependable water supplies in order to prosper. Desalting systems have long proven effective in Kuwait, Bahrain, Qatar, the United Arab Emirates, Oman, and Saudi Arabia. Where once there were bleak villages on barren deserts there are now bright modern cities with tree lined streets. There are homes with lush gardens. In the countryside there are productive farms. The big desalting plant at Jubail, Saudi Arabia, is a model for the world. A pipeline carries a river of freshwater 200 miles inland to the capital city of Riyadh, and desalted seawater has given a large region an entirely new future filled with opportunities. There are more than 7,000 desalination plants, mostly small ones, in operation worldwide. About two thirds are located in the Middle East, and others are scattered across islands in the Caribbean and elsewhere. Aruba's high-tech water plant has for many years met the needs of a thriving tourist industry.

The largest plant in the United States is the pioneering \$158 million project of the Tampa Bay Water agency. The project was left to contract in 1999 and after overcoming some technical problems in its early years is now performing well and causing no significant environmental problems. But no U.S. water agency has yet undertaken a really big project comparable to those found along the Arabian Gulf.

	2002	2003	2004	2007	2010
UAE	142.8	149.4	196.9	212.5	229.1
Bahrain	27.9	29.8	30.4	32.2	33.82
KAS	-----	252.7	279.52	318.24	207.28
Oman	20.69	21.5	22.85	23.95	26.14
Qatar	-----	33.5	34.8	35.6	35.6
Kuwait	82.11	102.06	91.05	94.99	97.88
Total	273.5	588.96	655.52	717.48	629.82

Table 2: Water consumption in Gulf States.

Towards a Strategy for Water Management in the Region

Certainly, water conservation programs should come first as a strategy for regions facing water problems. Many jurisdictions are

already imposing water use limits. Other communities try drilling wells deeper and deeper until their aquifer is maxed out, or they propose to pipe water from distant streams. But such shortsighted strategies can do incalculable damage to the environment

Water conservation programs should be carried out by the agency responsible for water resources management. The execution of such plans for the various sectors (such as municipal, agricultural, or industrial) should be co-ordinated by the relevant government body in each sector. Close co-ordination and partnership should be institutionalized between the agencies responsible for water supply, demand management, and education, media, and awareness. Unfortunately, the ministries of education, Awqaf, and Islamic Affairs rarely participate in water conservation programs. In the region, although this is essential for effective awareness activities.

Equally, the public's involvement and its co-operation in designing and implementing conservation measures are essential to the success of water conservation programs. The public includes consumers, service providers, managers, and planners as well as policy-makers. Raising public awareness using Islamic conservation concepts should always be integrated with the use of other communication tools and channels.

To achieve greater co-operation and involvement, the public must understand the water supply situation, including the cost of delivery, the overall water resources situation, and the need to conserve water resources and to maintain them for future generations. This increased understanding is the first step in any successful public awareness activity. However, the credibility of this information is essential. Because honesty is a core principle in Islam, the public expects the truth from imams and other Islamic sources. Most water conservation activities require changes of behavior and attitudes, which is usually a slow process. Therefore, ad hoc and occasional public awareness activities are not effective. Water authorities should plan continuous, long-term activities in close collaboration and coordination with ministries of Education and Islamic Affairs. Some water conservation activities involve costs that must be paid by the public, such as fixing water taps, upgrading irrigation systems, or modifying industrial production lines. These costs of water conservation programs must be offset by some incentives. In addition to the physical incentives, the spiritual incentives offered by Islam can be of value.

Water conservation activities and awareness campaigns typically focus solely on domestic users. This is shortsighted, and the focus should be on all water users. Mosques are ideal places for awareness campaigns, since all kinds of people meet there at least weekly. However, imams should be aware of the need to address all sections of the population. In the GCC countries, a shift in societal values from a development-oriented to a conservation-oriented view of water resources is occurring. It is believed in the GCC countries that conservation of natural resources in general, and water resources in particular, are a principal component of Islamic teachings. It is also believed that the most important and effective way to make the public aware of conservation from an Islamic perspective is through the media and the educational system [5]. Islamic messages are being used in the preparation of posters and video clippings for these campaigns. On the occasion of World Water Day 1998, and upon request of ministries of Islamic Affairs, imams were requested to devote their Friday speeches to the theme of Islam and water conservation [6]. But such occasional public awareness water conservation campaigns need to be integrated through a comprehensive and long-term plan of action that targets behavioral change [7], otherwise their effect will

limited water treatment and reuse is now one of the top priorities for governments across the GCC as populations increase and the demand on existing infrastructure and potable water generating capacity is stretched to the limits. More than funds will be invested in the wastewater and water reuse sector over the coming 20 years as Gulf states embrace the concept of full sewerage coverage and the need for conservation of scarce water resources. The investment drive in nearly every GCC state will be carried out by the private sector either in tandem with the government in public-private partnerships (PPPs) or through fully-fledged privatization.

Technology will continue to play an important role. Most states are still reluctant to utilize the more recent membrane bioreactor (MBR) technology, preferring to stick to conventional wastewater treatment applications, the exception being some of the smaller real estate players in Qatar and UAE. However, MBR technology is expected to take hold in the region. Sharjah is building a small-scale pilot STP for Ashghal using MBR and reverse osmosis technology. There are no plans, at the moment at least, for states to connect the treated wastewater network to potable water networks. 'It's a psychological fear,' said Salah al-Mutawa, manager of the treated sewage effluent department at Bahrain's Works & Housing Ministry. 'People aren't generally aware of the treatment process' [8,9].

Education and increasing public awareness are now firmly on the agenda. Both Dubai and Doha are thinking about public visitor centres to teach people about the benefits of water reuse and the processes involved in treatment. Cultural and religious factors will remain an obstacle to the implementation of a full-water reuse cycle, although states are now looking at using treated wastewater to recharge aquifers [10,11].

Conclusion

Integrated water resources management is the most feasible option to overcome the serious crisis of water shortage. Water conservation should be an integral part of this option, with a clear focus on public awareness and participation without which the chances of success will be lessened.

Access to information related to water conservation and public awareness activities is lacking in Gulf countries both because of the limited number of these activities, and because of poor information management and exchange. Such access can be improved by adopting a strategy to identify sustainable water management practices, documenting the experiences in water conservation and public awareness. This Strategy should be made available to water specialists as well as to the public by networking at the regional and national levels.

Gulf States can meet the challenge of global warming with a three-pronged approach: reducing emissions of carbon pollution, minimizing human stresses on ecosystems, and adapting to the challenges to come. Reducing the dependence on fossil fuels by developing clean energy sources would reduce global warming gas emissions and create jobs and new economic opportunities for region. By implementing the best practices in land and water resource use, policy-and decision-makers can minimize ecologically harmful side effects of climate change. And finally, elected officials and government leaders can plan ahead by increasing their flexibility and adaptive capacity in managing the state's precious water resources, agriculture, forests, ecosystems, and coasts.

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