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Water Demand Management Is a Must in MENA Countries… But Is It Enough?

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Abstract: The majority of Middle East and North Africa (MENA) countries suffer from chronic imbalance between available water supply and rising water demand. This imbalance is expected to worsen even further in the future as a result of sharp population growth, rapid economic development and climate change, unless major positive measures are implemented to augment water supply and manage water demand. The supply management approach, on its own, practiced by many countries in the region for so many years has so far demonstrated its inability to bridge the "water gap" between available water resources and rising water demand, as most traditional water resourced in almost all MENA countries have been exploited (or over exploited), and the cost of non-traditional water resources has become increasingly prohibitively high, apart from its environmental impact. Demand management is regarded by many water experts in the region as the answer or "panacea" for the water imbalance problem. But, is demand management approach alone able to solve the problem of water scarcity in the MENA region? In other words, if all demand management measures have been fully implemented, would there still be gaps between supply and demand that need to be filled with supply augmentation, andwill supply management options still need to be part of the solution? This paper tries to answer this question by reviewing several works in this domain, particularly, recent studies by the World Bank [9-11]. It was concluded that, although water demand management measures should be given the first priority, especially, in the agricultural sector where it has the maximum impact, demand management on its own will not be able to bridge the "water gap", and supply management options, such as sea water desalination and the re-use of treated wastewater, will be part of the solution.

Key words: MENA countries, demand management, water scarcity, water gap.

1. Introduction

The renewable water resources in the MENA region are among the lowest in the world. The majority of MENA countries (17 out of 21) have crossed the "water poverty/scarcity" threshold (set by the UN-Food and Agriculture Organization, FAO, of 1,000 cubic meters of renewable water resources per capita per year, m^3/capita/year) (Table 1) [4, 9]. And eight countries (out of 21) are under sever water stress conditions (as their total renewable water resources are less than 200 m^3/capita/year). Only four countries in the MENA region, their per capita total renewable water resources exceed the water scarcity threshold.

It is worth mentioning here that the figures mentioned in Table 1 for the various MENA countries are sometimes different from the figures reported in AQUASTAT (the FAO global information system on water and agriculture). For example, in AQUASTAT, Iran is classified currently as a country with no water stress (i.e., its water scarcity index is greater than 1,000 m^3/capita/year), whereas in the World Bank study, Iran is classified as a country with moderate water stress (i.e., its water scarcity index is between 500 and 1,000 m^3/capita/year). Furthermore, Syria is classified as a country with a current moderate water stress in AQUASTAT [12], whereas it is classified as a country with no current water stress in the World Bank study. Perhaps the most striking example is Libya. It was classified as a country with severe water stress in AQUASTAT [12], whereas it is classified as a country with no current water stress in the World Bank study.

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Table 1 Per capita share of renewable water resources in MENA region, by country, 2000-2009.

Renewable water resources (cubic meters per capita per year)			
Less than 200	200-500	500-1,000	Greater than 1,000
Bahrain	Lebanon	Algeria	Djibouti
Jordan	Morocco	Egypt	Iraq
Kuwait	Oman	Iran	Libya
Malta	Qatar		Syria
Occupied Palestine (Israel)	Saudi Arabia		
United Arab Emirates	Tunisia		
West Bank and Gaza			
Yemen			

World Bank 2012 and FutureWater 2011.

Table 2 Projected per capita share of renewable water resources, by country 2020-2030.

Renewable water resources (cubic meters per capita per year)			
Less than 200	200-500	500-1,000	Greater than 1,000
Bahrain	Algeria	Libya	-
Jordan	Djibouti	Syria	-
Kuwait	Egypt	-	-
Lebanon	Iran	-	-
Malta	Iraq		
Morocco	Occupied Palestine (Israel)		
Oman	Iran		
Qatar			
Saudi Arabia			
Tunisia			
United Arab Emirates			
West Bank and Gaza			
Yemen			

World Bank 2012 and FutureWater 2011.

The MENA water resources situation will, undoubtedly, deteriorate further in the future mainly due to population growth and the impact of climate change (Table 2) [4, 9].

It is evident from Tables 1 and 2 that under current conditions (2000-09), countries in the Gulf region face the largest per capita water scarcity in MENA, with an average water availability of less than 300 m^3/capita/year. This situation will become even more severe in the future as a result of global warming and growing population.

It is also evident that, in total, by 2050, 14 of the 21 MENA countries could have less than 200 m^3/capita/year of renewable water resources, putting them under sever water stress conditions.

2. Water Demand and the Water Gap

Water demand is expected to increase 50 percent by 2050 in the MENA region if current rates of growth continue and the global climate warms as expected (Table 3) [9]. The current total water demand in MENA countries already exceeds naturally available water supplies by almost 20%. However, by 2050, the water demand gap is projected to grow 500%, from 42 BCM per annum to 199 BCM per annum (Table 3). This means that by 2030, due primarily to growing populations and partly to a warming climate, lack of water availability will become a severe constraint to socioeconomic development in all 21 MENA countries.

Table 3 MENA current & future water demand and the water gap (MCM).

	Water demand			Water gap		
Country	2000-2009	2020-2030	2040-2050	2000-2009	2020-2030	2040-2050
Algeria	6,356	8,786	12,336	0	0	3,947
Bahrain	226	321	391	195	310	383
Djibouti	28	46	84	0	0	0
Egypt	55,837	70,408	87,681	2,858	22,364	31,648
Iran	74,537	84,113	97,107	8,988	21,767	39,939
Iraq	50,160	67,235	83,803	11,001	35,374	54,860
Occupied Palestine (Israel)	2,526	3,396	4,212	1,660	2,670	3,418
Jordan	1,113	1,528	2,276	853	1,348	2,088
Kuwait	508	867	1,216	0	313	801
Lebanon	1,202	1,525	1,869	141	472	891
Libya	4,125	4,974	5,982	0	1,382	3,650
Malta	45	62	75	0	22	36
Morocco	15,739	19,357	24,223	2,092	9,110	15,414
Oman	763	1,091	1,709	0	24	1,143
Qatar	325	381	395	83	209	246
Saudi Arabia	20,439	22,674	26,633	9,467	14,412	20,208
Syrian Arab Republic	15,311	17,836	21,337	323	3,262	7,111
Tunisia	2,472	3,295	4,452	0	0	837
United Arab Emirates	3,370	3,495	3,389	3,036	3,243	3,189
West Bank and Gaza	460	680	1,022	308	591	925
Yemen	5,560	7,069	12,889	1,120	2,573	8,449
Total	261,099	319,138	393,082	42,125	119,443	199,183

World Bank 2012 and FutureWater 2011.

It is worth mentioning here that some of data in Table 3 are unclear and confusing. For example, it is unclear why the World Bank/FutureWater study estimated the current unmet demand gaps for Iraq and Iran at 11 BCM and 9 BCM, respectively. These figures seem unrealistic for countries that normally have positive water balance at the national level. No logical explanation was provided for this data. Similarly, the current demand gap of zero for Djibouti, Kuwait, Libya, and Malta, and especially the figure of zero demand gap for Djibouti until 2050 are also bizarre and unrealistic, and can only be attributed to the poor and unreliable data quality for some of the countries.

Currently, the water demand gaps (unmet demands) are filled primarily through over exploitation of groundwater reserves, and partially by increasing water supplies through desalination.

It is obvious from Table 4 that the agricultural sector dominates as the largest water consuming sector in all MENA countries, and it will continue to do so in 2050. However, its share of total water demand for agriculture will drop from 82% to 67% in 2050.

3. Water Demand Management Options

Several definitions of water demand management (WDM) exist in Refs. [2, 6]. In its simplest form, WDM is defined as getting the most of the water we have [1]. Other definitions include: “A practical strategy that improves the equitable, efficient and sustainable use of water” [3] and “The development and implementation of strategies aimed at influencing demand, so as to achieve efficient and sustainable use of a scarce resource” [8]. The Global Water Partnerships state that “WDM requires a holistic approach that recognizes the complexity of the inter-relationships among all the factors affecting water demand. It calls for the creation of an enabling environment based on

Table 4 MENA annual water demand and supply, 2000-2050 (BCM).

	2000-2009	2020-2030	2040-2050
Total demand	261	319	393
Irrigation	213	237	265
Urban	28	50	88
Industry	20	32	40
Total supply	219	200	194
Surface water	171	153	153
Groundwater	48	47	41
Total unmet demand	42	119	199
Irrigation	36	91	136
Urban	4	16	43
Industry	3	12	20

World Bank 2012 and FutureWater 2011.

an adequate set of mutually supportive policies and a comprehensive legal framework with a coherent set of incentives and regulatory measures to support these policies" [5].

In summary, WDM is about as the adaptation and implementation of a strategy by a government or a water institution to curb the rising water demand in order to achieve sustainability of water supply and services, economic efficiency, social development and environmental protection.

In water scarce regions such as MENA, WDM tries to strike an acceptable balance between limited water resources and increasing water demands, using policy and technical means. Therefore, it involves measures that are taken on the policy, legal, institutional and technical sides.

On the policy side, in MENA countries, reform of policies that encourages inefficient water use should be undertaken. And since the agricultural sector is the largest water consuming sector in the MENA region (81% of water use), reform of agricultural policies should be given high priority.

In most MENA countries, food security has been a major concern, particularly for staples, such as wheat. This desire for food security has led many MENA governments to invest substantially in irrigation systems, and subsidize both inputs (such as pumps, irrigation technology, and electricity) and outputs through price support mechanisms [9]. This has led to a huge expansion in irrigated agriculture, particularly groundwater-based agriculture which resulted in over exploitation of ground water in many countries in the region.

A reform of agricultural policies is needed to encourage countries to grow more of low water consuming crops that can be exported, while increasing imports of lower-value crops such as staples. Furthermore, all perverse incentives that encourage excessive water use should be abolished.

It is worth mentioning here that some MENA countries have made significant progress in reforming their agricultural policies to reduce water demand and encourage water conservation. In the United Arab Emirates, for example, groundwater mining was practiced on a large scale to irrigate fodder crops. In 2010, the UAE government eliminated subsidies for irrigated Rhodes grass (grown for animal feed) which has significantly reduced its annual agricultural water consumption. Nevertheless, the UAE Water Conservation Strategy published, in 2010 by the Ministry of Environment and Water, concluded that "polices associated with water demand management have not played a large part in the current water strategies of the UAE, but if properly researched and formulated could achieve a significant reduction in both total consumption and related future investments

in production capacity and infrastructure". This constitutes a clear indication that there are still ample water demand management options that could be implemented which could curb the rise in water demand in the UAE.

On the technical side, increasing water use efficiency in the agricultural, municipal and industrial sectors should be given the highest priorities. In the agricultural sector, water use efficiency is still between 50% to 60% in the MENA region, despite the predominance of modern irrigation systems. This should be increased to more than 80% by using improved irrigation scheduling, management, and technology.

Furthermore, MENA's physical water losses in municipal and industrial supplies also exceed world averages. These water losses are approximately 30% to 50% in some cities, compared to international best practice of approximately 10% [9]. Strategies to manage domestic water demand should be developed and implemented. These should aim primarily at reducing physical losses (due to leakage) and nonphysical losses (illegal connections, faulty meters, etc.) in the supply side, and reducing water consumption on the demand side using economic tools such ascending block rate structure for water tariff that penalizes excessive water use.

4. Demand Management Is Not Enough

The impact of several water demand management alternatives was studied and assessed (including improved agricultural practice, increased reuse of water from domestic and industrial uses, increased reuse of water in irrigated agriculture, expanding reservoir capacity, reduction in irrigated areas; reduction in domestic and industrial demand of water supply etc.) [9]. It was concluded that improved agricultural practice is the preferred technical option as it can reduce the "water gap" by 55 BCM per annum if this option is implemented in the MENA region.

Needless to say that the applicability of these options may differ from one country to another in the MENA region, as certain alternatives might not be feasible to implement politically or socially. For example, reducing irrigated area is not an easy option to implement politically given the sensitivities surrounding food security in many countries in the region, and governments may choose to invest in adding new water (through desalination) rather than reducing irrigated area.

However, even if all demand management options are implemented, there will still be a water demand gap in MENA countries of approximately 93 BCM. This gap has to be filled by new water supplies coming from non-conventional water sources, namely desalination and treated wastewater [9].

Treated wastewater is an assured resource and is expected to increase as the population grows. It constitutes a reliable water resource that is available all year round and is independent of climate, especially in arid countries such as Gulf Cooperation Council countries. The potential for domestic water reuse is large in MENA countries, bearing in mind that actual domestic consumption of water accounts for approximately 10% of household demand. If only 50% of this potential wastewater were recycled, it could add 20-40 BCM per year to MENA's renewable water resources by 2050 [9]. However, wastewater treatment and reuse need investment to extend collection and treatment networks. Most important, wastewater recycling needs to be explicitly included in national water planning policies, and well-designed campaigns are needed to ensure the public's acceptance of its use.

Desalination of seawater and brackish groundwater holds significant potential to bridge the water demand gap in MENA. Desalination already plays a critical role in MENA's water supply, particularly for countries in the Gulf region. This role is expected to extend to most countries in the MENA region by 2050. Seawater effectively is an infinite water resource. Brackish groundwater reserves could be used to support salt-tolerant agriculture and/or be a source of

desalinated water. Brackish groundwater reserves in MENA potentially are large, but extensive exploration is required to better define this resource. Desalination of brackish groundwater usually is much cheaper than desalinating seawater—the only alternative to groundwater in most MENA countries. However, for large-scale applications, seawater desalination provides the most obvious solution to MENA's water supply shortage.

5. Summary and Conclusions

Currently, the majority of countries in the MENA region (17 out of 21) have crossed the water scarcity threshold of 1,000 cubic meters of renewable water resources per capita per year. Most of MENA countries suffer from chronic imbalance between available water supply and rising water demand (demand gap). This imbalance is expected to worsen even further in the future as a result of sharp population growth, rapid economic development and climate change. The current water demand gap is projected to grow 500%, from 42 BCM per annum to 199 BCM per annum by 2050. Although demand management should be given first priority to bridge the water gap, however, it will not be able, on its own, to fill this gap. Even if all demand management options are implemented, there will still be a water demand gap in MENA countries of approximately 93 BCM, which should be met by "new" water supplies coming from non-conventional water sources, namely desalination and treated wastewater. Desalination will continue to play a major role in bridging the water gap in MENA region.

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