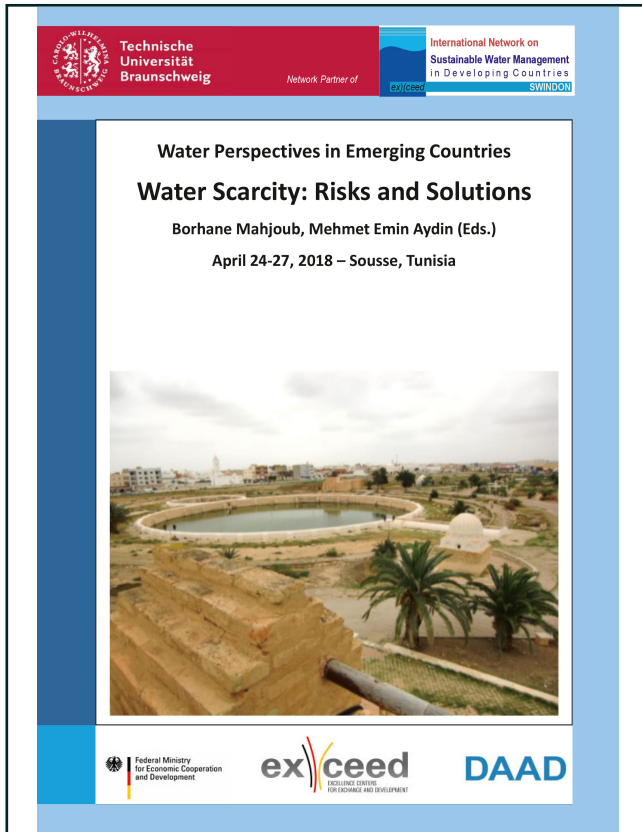




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## **Water Scarcity: Risks and Solutions**

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# CHALLENGES TO THE WATER SECTOR IN THE MENA REGION

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## **Abstract**

The water sector in the MENA region faces many challenges that hinder its social and economic development. These challenges can be classified as natural, social, policy, technical, financial, governance and institutional, transboundary, and political. Natural challenges include frequent droughts and climate change; social challenges include high population growth, social misconceptions that impact water use behavior, and corruption. Technical challenges refer to low water use efficiency, especially in the agricultural and domestic sectors. Policy challenges include poor allocation among the different competing demands as most of the available water resources are allocated to the agricultural sector, and poor cropping practices in the agricultural sector. Economic challenges include lack of funds and low level of cost recovery in most of the MENA countries. Governance and institutional challenges refer to the lack of effective coordination and unclear lines of responsibilities among the different governmental bodies in charge of water resources management. This paper discusses these challenges to some detail.

## **1 Introduction**

Sustainable water resources management is a key to socio-economic development and environmental protection. In the Middle East and North Africa (MENA) region, sustainable water resources management faces serious challenges, which deter socio-economic development and negatively impact the environment. Among these challenges are drought, high population growth, low water use efficiency, climate change, lack of financial resources, poor management of trans-boundary resources, lack of funds and low cost recovery, improper institutional set up and governance, and political instability. These challenges have led to a persistent and ever growing imbalance between the rapidly increasing water demands and the dwindling supplies in most of the MENA countries.

Water availability in most of the MENA countries, with the exception of Egypt and Sudan, is below the water poverty level of 1000 m<sup>3</sup>/capita.yr [1]. In addition, twelve countries from the Arab world, which makes the majority of the MENA region, are in the state of water crises, where the annual per capita share of fresh water resources is below 500 m<sup>3</sup>. Of the twelve countries, nine are under the state of absolute water scarcity, where the annual per capita water share is below 165 m<sup>3</sup> [2]. It is important to note that there is no single definition of the MENA region in the literature. However, for the purpose of this paper, the MENA region is shown in Figure 1.



Figure 1: Map of the MENA region [3]

Challenges to the water sector in the MENA region are grouped into the following categories, which are described and discussed below: natural, social, policy, technical, poor governance and institutional setup, lack of financial resources, political instability, and transboundary resources.

## 2 Natural challenges

Drought is a natural challenge, the impacts of which can be mitigated by sound planning and management of water resources and demands. It is estimated that about 80% of the Arab countries' land is barren, where the average annual precipitation ranges between 0 and 180 mm (Figure 2), while the average annual evaporation is more than 2000 mm [4]. According to the Arab Center for the Studies of Arid Zones And Dry Lands (ACSAD) [5], the Arab World receives only 2.1% of the world's average annual precipitation, despite the fact that it makes 10% of the world's total area, and 5% of the world's population. In addition, about 2000 billion cubic meters (BCM) of rain fall in the Arab world; however, huge proportion of this rainfall is lost due to high evaporation and evapotranspiration rates [4]. Low precipitation, high evaporation rates and global warming are threatening the ecosystems in several MENA countries and causing desertification. According to Varis and Somlyódy [6], 14% of Algerian land and 52% of Moroccan land are threatened by desertification, while 30-40% of Egypt's land is threatened by salinization. To combat desertification and environmental degradation, the MENA governments should establish regulations that promote ecofriendly water use [7].

Climate change is another challenge to the water sector in the MENA region. Based on global and regional models, it is projected that the MENA region will become drier due to the higher near-

surface air temperature, lower precipitation and higher evaporation rates, which will have threatening consequences on all vital sectors [8]. According to Chenoweth et al. [9], a study of climate change impact on water resources predicted a decrease in precipitation of about 4% between 2040 and 2069 in the Middle Eastern countries. An increase in precipitation of 30.7% is projected for Kuwait and of 27.9% for Qatar, while for Jordan and Lebanon precipitation is projected to decrease by 16.6% and 14.7%, respectively.



Figure 2: World's average annual precipitation [10]

### 3 Social challenges

Population growth rate in the MENA countries is among the highest in the world, which is due to social as well as religious factors [11]. The population in the Arab countries has jumped from 128 million in 1970 to 359 million in 2010 [12], which are projected to reach about 692 million by 2050 [12, 13]. This population increase, in addition to the socio economic development, resulted in dramatically enlarging the gap between the limited available resources and the increasing demands [14]. The per capita share of available water resources in several MENA countries has dropped to extremely low levels over the last three decades as a result of high population growth [2]. According to the population projection of the United Nations, the annual per capita water share in Jordan is expected to drop from 110 m<sup>3</sup> to 56 m<sup>3</sup> by the year 2050. In Lebanon, the rather high annual per capita water availability is projected to decrease from 900 m<sup>3</sup> to 725 m<sup>3</sup>, placing Lebanon below the water scarcity level [15]. Furthermore, the average per capita domestic water consumption in the Arab World is about 200 L/d, which varies significantly among the different Arab countries as well as among the different regions within the same country. In the Gulf Cooperation Council (GCC) countries, water consumption is among the highest in the world [14], as evidenced by the dramatic increase over the last three decades. In Kuwait for example, the per



capita water consumption was about 200 L/d in the 1980s, which increased to about 500 L/d in the 2000s. Reasons advanced for this dramatic increase in the per capita consumption are the relatively high income and the socio-economic development on one hand, and the low municipal water tariffs on the other hand [16].

#### **4 Policy challenges**

Despite the fact that most of the MENA countries suffer from severe water shortage, water resources in most of these countries are not managed in an integrated sustainable manner. The mismanagement includes improper allocation among the different sectors, where the agricultural sector consumes the lion's share of the available resources. It is estimated that irrigated agriculture in the Arab world consumes about 87% of the available resources [17], despite the fact that the contribution of the agricultural sector to the national economy in the Arab World is too low [18]. Public policies of subsidies and underpricing encouraged overuse in the agricultural sector to meet the high food demand as a result of high population growth rate [19]. It is interesting to know that the benefit from these subsidies went to the rich farmers rather than to the poor. For example in Egypt, subsidies to the agricultural sector were justified to help the poor, to the contrary, it turned out that these subsidies benefited the rich households [2]. Furthermore, agricultural water use in the Arab World increased from about 160 BCM in 1995 to more than 200 BCM in 2003 [20]. This dramatic increase in the agricultural water use was driven by food security policies, however, food production in most of the Arab countries had not responded to this dramatic increase in agricultural water use [21, 22]. In the Gulf countries, policies that target self-sufficiency in strategic crops, i.e., wheat and forage resulted in dramatic over use of non-renewable fresh groundwater resources [11].

Reallocation of the limited water resources in the Arab World among the competing demands agricultural, domestic and industrial based on certain optimization techniques is a management option that ensures sustainable use of the limited water resources as well as their equitable distribution [23]. This can be a long-term policy option to conserve and efficiently manage water resources in a sustainable manner as well as to protect the environment. Reallocation can take place among the sectors themselves as well as within the same sector. For example, in the agricultural sector, water can be reallocated towards cash crops to maximize the net benefit of the water used in this sector. Furthermore, instead of developing new supplies to meet the increasing demands, focus should turn to conserving the existing supplies and reallocation of water rights [24], which should be accompanied by legal and institutional changes designed to promote voluntary reallocation [25].

#### **5 Technical challenges**

The extremely low water use efficiency in the agricultural sector in the MENA countries is responsible for considerable proportion of the increase in the agricultural water use. It is estimated that irrigation water use efficiency in the Arab World is as low as 30-40% [26]. The low water use efficiency in the agricultural sector is mainly attributed to the wide spread of traditional inefficient

irrigation methods [26-28]. Surface irrigation is practiced in about 80% of irrigated land, sprinkler irrigation is practiced in 23%, and micro-irrigation is practiced in only 2.8% of irrigated areas in the Arab World [29, 30]. For example, about 80% of water resources in North Africa are allocated to agriculture. It is estimated that 52 BCM water can be saved annually by reducing conveyance losses by 50% and by raising irrigation efficiency from its current level at 40-50% to 80% [31].

Similar to the agricultural sector, the municipal sector in the Arab World suffers from mismanagement represented by high subsidies, which lead to low cost recovery [16]. This in turn makes it difficult for the water authorities to maintain the water distribution system, which led to its gradual degradation resulting in elevated Non-Revenue Water (NRW) levels (lost water volume per km pipeline and day). High NRW level is a characteristic of water supplies in the Arab World, which is a big challenge to the sustainability of the water sector services. NRW is estimated at 54% in Algeria 53.9 m<sup>3</sup>/(km.d), 40% in Bahrain (59 m<sup>3</sup>/km.d), and 36% in Jordan (14.8 m<sup>3</sup>/km.d) [32], which is equivalent to 80 MCM per year [16]. In Yemen, NRW ranges between 20-60% in urban areas and 40-60% in rural areas. For the year 2008, NRW in Yemen was estimated at 43 MCM, which costs about US\$ 22 million [16]. Figure 3 shows the NRW for selected MENA countries [33].

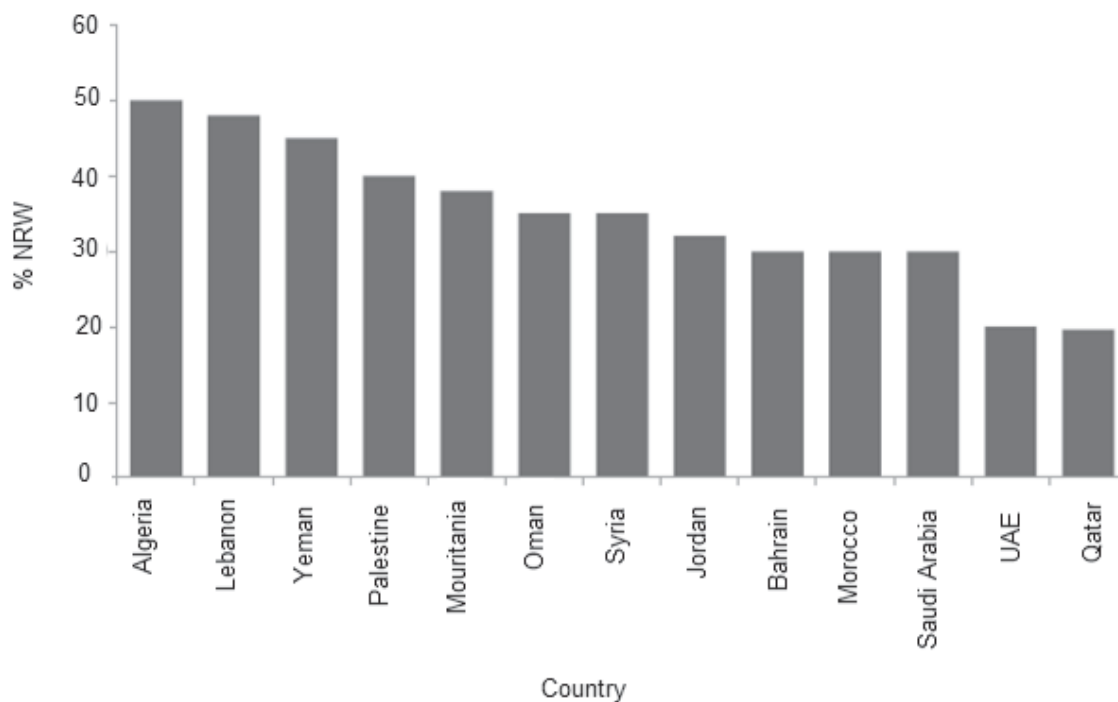


Figure 3: Non-revenue water for selected MENA countries [33]

## 6 Poor governance and institutional setup

Improper institutional set up, where no clear boundaries among the responsibilities of the different institutions in charge of the water sector exists, resulted in poor governance in this sector aggravating the impact of water shortage [17]. In the MENA countries, in general, irrigation and drinking waters are administered by different governmental bodies with no clear guidelines for coordination among them [34]. Institutions responsible for water in the MENA take pricing



measures to increase revenues only without taking into consideration the pricing impact on the behavior of the end-use. The poor performance of many water utilities in the MENA region is, in most cases, due to lack of financial resources, mismanagement and the tendency to administer a utility as government department not as a private entity which creates problems of unclear responsibilities for operation, low tariffs, difficulty retaining qualified personnel, lack of necessary legislation and political interference [11].

## **7 Lack of financial resources**

Lack of financial resources to maintain and to upgrade water infrastructures such as water distribution system and storm water collection system in many of the Arab countries is a major challenge to the sustainability of the water sector in these countries. In wet years and extreme rainfall events, the storm water collection system and water harvesting infrastructures in many of the Arab World are incapable of handling the generated runoff, which results in property damage and some cases of life loss. In the years 1993, 2003 and 2013, the Middle East witnessed intensive rainfall and snow storms originating from Siberia, causing vast destruction to the fragile low-capacity infrastructures [11].

The low cost recovery due to high subsidies and high NRW levels in the municipal sector made it impossible for water authorities in the Arab World to develop new resources without soliciting funds from international aid agencies. It is important to mention that raising municipal water tariff in the Arab World has been and will always be a politically sensitive issue taking into consideration that access to safe drinking water is now considered as a human right [35]. Among the MENA countries, Tunisia has set an example of efficient water tariff that takes into consideration the human right access to drinking water for the poor and enables the water utility to recover the cost [33]. Despite the water shortage and the many challenges to the water sector in the Arab World, many Arab countries had improved their drinking water services and many were on track to achieve the Millennium Development Goal 7.C (MDG 7.C) [16], which was “halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation”. In the year 2012, about 82% of the people in the region had access to improved drinking water [36].

## **8 Political instability**

The MENA region has been politically unstable during the past several decades, as evidenced by the several wars and revolutions that took place and are still ongoing. Political instability in the region has resulted in sudden fluxes of refugees to certain neighboring countries such as Jordan, Lebanon and Turkey, which resulted in huge pressure on all resources, more specifically on water resources. In addition to the instantaneous flux of refugees, political instability in the region has resulted in sustained demographic changes, which also required more efficient use of available natural resources to sustain social and economic development.



## 9 Trans-boundary resources

Several countries of the MENA region depend on trans-boundary water resources to satisfy their demands. Two-thirds of the Arab world's surface water supplies are trans-boundary [37]. Roughly speaking, about 90% of the Euphrates's annual flow, and 50% of the Tigris' water supply originates from Turkey [38]. In addition, more than 50% of Iraq's renewable water resources are trans-boundary. Moreover, about three quarters of Sudan's and Syria's water resources originate outside their borders. Furthermore, Bahrain, Egypt, and Kuwait depend on external sources for more than 95% of their demand [39].

Trans-boundary water resources can lead to competition and conflicts between upstream and downstream countries about water rights. In the absence of agreements among the riparian countries that regulate water rights, trans-boundary water resources are not a reliable water resource for downstream countries, which is the case in the MENA region. More sustainable trans-boundary water resources management practices are needed in the MENA region to protect and to sustain social and economic developments of the downstream countries.

## 10 Concluding remarks

The MENA region is classified among the poorest in the world in terms of water resources. In addition to the water shortage, which is natural, the water sector in the MENA region faces serious challenges that threaten its social and economic developments. In order to foster and to sustain the socio-economic development of the MENA region, governments and water authorities have to grasp to and to seize available opportunities such as improving financial management, raising public awareness about water scarcity, implementing demand management strategies, implementing policies that encourage more efficient water use and improved governance, better management of trans-boundary water resources, and promoting peace in the region.

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