Mediterranean Water Outlook: Perspective on Policies and Water Management in Arab Countries

Khaled M. AbuZeid

Abstract The Mediterranean Region is usually characterized by its water stress situation. However, water availability is completely different between the North and the South (including the East) of the Mediterranean Sea. While the North may enjoy more than adequate amounts of rainfall, it is mostly the South that gives the Mediterranean Region the identity of water scarcity. The countries in the south and the east of the Mediterranean Sea include the eight Arab countries, Morocco, Algeria, Tunisia, Libya, Egypt, Palestine, Lebanon, and Syria.

This chapter gives an outlook on the water characteristics in the Mediterranean countries, in terms of per capita share of renewable water resources, as well as sectoral water uses by country. It highlights the different levels of dependencies between the North and the South, on the different forms of water, and in particular different dependencies on "green water" and "blue water" in sectoral uses. This chapter also reflects on the status of water supply and sanitation services coverage in the Mediterranean countries and the requirements to achieve the Millennium Development Goals in water supply and sanitation. Potential for sectoral water savings and wastewater reuse in the Mediterranean countries is presented.

The various regional strategies and legal frameworks that govern water management in the Mediterranean countries at the European, Mediterranean, and Arab Region levels are presented.

This chapter also presents a perspective on the required uniqueness in national policies and water management in the Arab countries in the Mediterranean due to water issues that characterize the Arab countries in the Mediterranean such as those related to nonrenewable groundwater management, transboundary water management, water scarcity, sea water intrusion, and wastewater reuse. The status of Integrated Water Resources Management (IWRM) plan development in the Arab countries in the Mediterranean is presented.

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1 Introduction

Like most parts of the world facing increasing population and escalating water demands, the Mediterranean Region is not an exception. It is thus imperative for each country and for every region to assess the state of the water on a regular basis, to stand on the situation regarding water resources availability, sectoral uses, new infrastructure, physical changes, governance developments, and trends that provide interpretation of the past water sector evolution.

It is always important to take a pause, analyze changes, synthesize causes, evaluate impacts, identify cross-sectoral relations, and determine multidisciplinary linkages to be able to carefully project an outlook for the future. In the water sector, this is an important step that is always needed for efficient Integrated Water Resources Planning (IWRM).

2 Water Challenges in the Arab Mediterranean Region

The precipitation situation in the Mediterranean Region is different from the north to the south, and the region has a number of transboundary rivers and especially in the south Mediterranean, and this has its impact on the land use of the Mediterranean. This clearly can be observed from the increased green vegetation in the north of the Mediterranean Region, as compared to the south and east of the Mediterranean Region where countries' vegetation is restricted to river basins and the rainfall areas in the thin fringes of the northern coast of the south and east Mediterranean Region.

The water challenges in the Mediterranean Region especially in the Arab countries that are located in the drier areas in south and east Mediterranean are indicated by the following issues:

- Water scarcity and the growing supply/demand gap
- Coordination between different water sectors and stakeholders
- High dependency on transboundary waters
- Limited information on water resources
- Overlap of responsibilities
- Water quality degradation and water pollution
- Limited public awareness on water resources issues
- Lack of funds for water resources and services development

- Capacity building and institutional development
- Effective legislations and law enforcement

The current population in the Mediterranean Region in 2010 is about 445 million people, water used in irrigation is about 180 billion cubic meters (BCM) per year, domestic water use is about 40 BCM/year, and industrial water use is about 65 BCM/year, and it is expected that the population number will increase by 2050 to reach 600 million with an increase in water demand of about 25 %.

Most of the Arab countries in the south and east Mediterranean are below the water scarcity limit. There are two countries that fall above the water scarcity limit of 1,000 m^3/capita/year of renewable water resources, an internationally known standard number for the minimum amount of national per capita renewable water resources adequate enough for the different needs in the agriculture, industry, and domestic sectoral uses. In 2025, it is expected that all countries will be below that water scarcity limit for the south and east countries of the Mediterranean Region. All countries in the north of the Mediterranean Region are above the water scarcity limit, and the water situation is different from the north to the south.

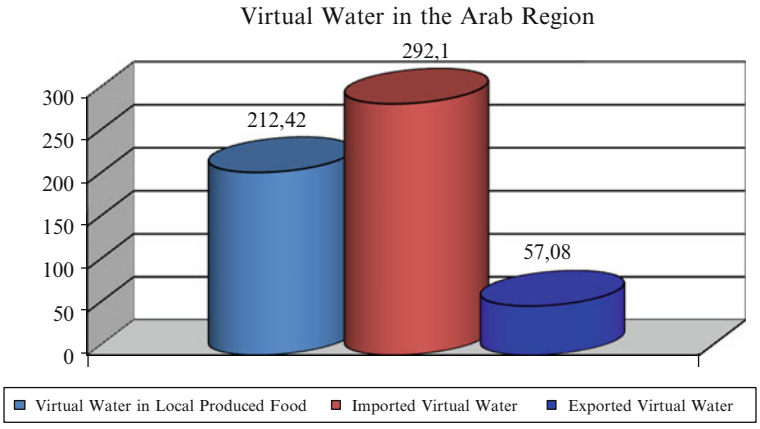
Cultivated areas, in France, are about 80 million acres, with 8 % in irrigated areas, and the remaining area is rain-fed agriculture and natural vegetation. The Rhone River, in France (north Mediterranean), discharges into the Mediterranean about 50 km^3/year. Whereas in Egypt, there are only 8 million acres of cultivated areas, and 100 % of this area is irrigated agriculture. On the other hand, the Nile River in Egypt (south Mediterranean) runs in the middle of the Deseret, and the only green areas exist in the thin strip around the Nile as irrigated agriculture. As Egypt does not receive that much rain, Egypt depends mainly on the Nile River and utilizes about 55.5 km^3/year for all its different uses without any freshwater flows into the Mediterranean, which is almost the same amount that the Rhone River discharges into the Mediterranean without use.

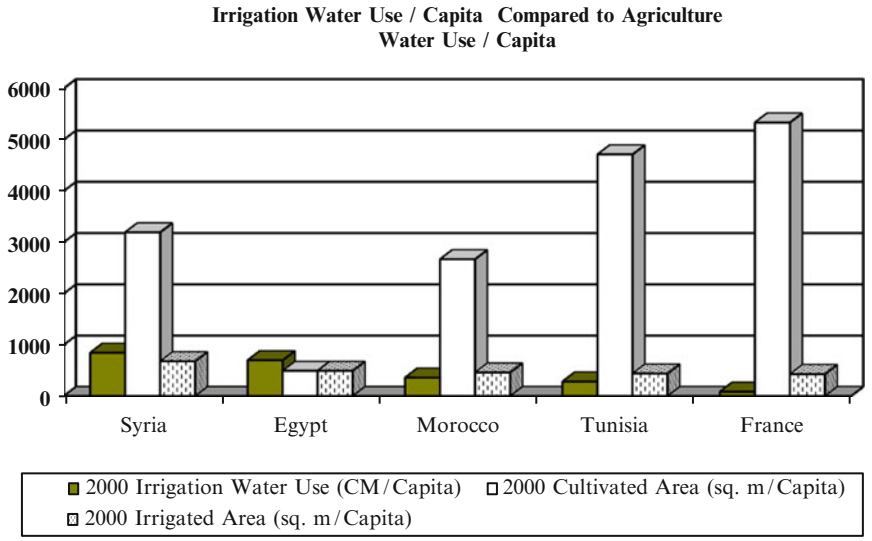
3 The Blue Water/Green Water Concept

The world receives about 110,000 km^3/year of precipitation, where about 60 % of which is considered as green water, and about 40 % is blue water. *Green water* is the water that is used directly from the rainfall for green vegetation whether it is rainfall agriculture, forests, or grazing land. *Blue water* is the surface water that runs into the rivers and all the water that can be abstracted from the ground water. Green water use for crop production, all over the globe, is more than blue water. However, in the Arab Region, the case is the opposite, which reflects rainfall scarcity and the external transboundary nature of its waters. In the Arab Region, there is about 170 km^3/year of blue water which contributes to food production, whereas there is about 45 km^3/year of green water that contributes to food production in the region. The Arab Region imports lots of virtual water because of water scarcity. In the Arab Region, about 215 km^3/year of virtual water is consumed locally for food production,

and 57 km^3/year of virtual water is exported in food products, while 295 km^3/year of virtual water is imported as food products.

Several of the water assessments confuse irrigated areas with cultivated areas and ignore rain-fed agriculture areas. Irrigation water withdrawals are wrongly considered as the only agriculture consumption and are used for benchmarking countries and sometimes are wrongly used to assess countries' water use efficiency. However, as seen in the figure below, when properly assessed, agriculture water use should be divided into irrigated agriculture water use and rain-fed agriculture water use.

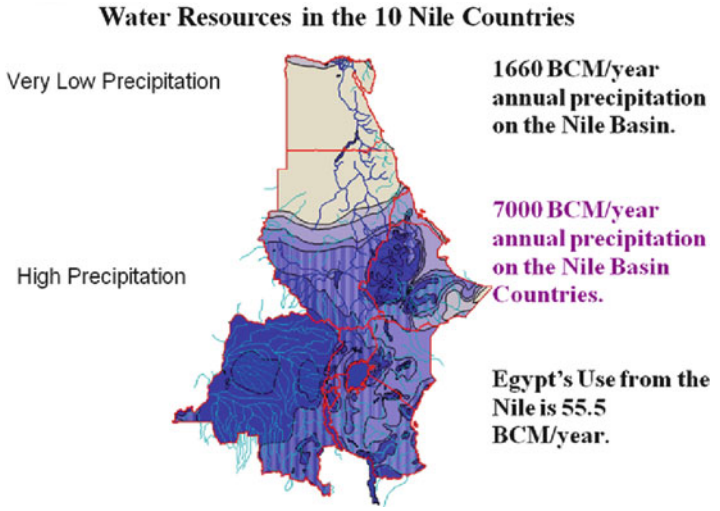


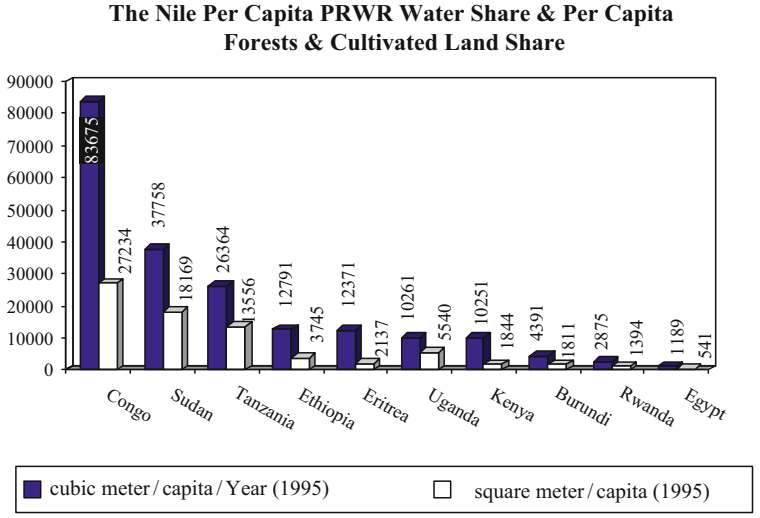


The per capita share of irrigated agriculture area in the north of the Mediterranean is small compared to the countries south of the Mediterranean; however, the per capita share of rain-fed agriculture in north Mediterranean countries is larger than that in southern Mediterranean countries. Oftentimes, it is wrongly perceived that southern Mediterranean countries are not efficiently using water or using too much water for agriculture, and that this water should be shifted to industry; however, this may not be the case as the dry nature of the region obligates the countries to use more irrigation than rain-fed agriculture, and irrigation water withdrawals are often assessed and computed while rain-fed water is not commonly assessed. The fact that a lot of water is directed to irrigation in the south part of the Mediterranean Region does not mean that water is used in agriculture rather than other uses, but it is because in the north, most of the agriculture area depends on rainfall rather than irrigation water, and nobody calculates how much rainfall or green water is being used for agriculture. CEDARE and the Arab Water Council were the first to assess green water uses in the Arab countries in the first Arab State of the Water Report in 2004.

4 The River Basin Versus the Watercourse Approach in Transboundary Waters

The importance of green water emphasizes the fact that in a transboundary river basin water sharing, the water resources in the whole river basin should be considered for reasonable and equitable utilization rather than just the waters in the river itself or the watercourse. For example, the Nile River basin shared by 11 countries, now after the separation of South Sudan, receives an average of about 1,660 BCM of annual precipitation on the Nile basin, and the Nile basin countries within their borders receive 7,000 BCM/year of average precipitation. Egypt use from the Nile is 55.5 BCM/year (AbuZeid 1997). When considering the green and blue waters within the river basins and within the borders of the riparian countries, the Nile per capita water share for each country may be presented, as shown below. This is also correlated with the per capita share of green cover "forests, cultivated, and pasture land" in the Nile countries. It is essential to differentiate between the water in the Nile River and water in Nile River "basin." Especially for countries downstream that fall in arid zones such as south and east Mediterranean countries, it is important to clarify which waters are to be considered when applying the principle of equitable and reasonable utilization. It should be the waters of the river basin and not the waters of the watercourse itself on which downstream countries may be more dependent than upstream. It is also important to consider water resources beyond the basin and within the country borders to assess dependency on the waters of the transboundary river basin (AbuZeid 2008).





The 1997 UN convention on non-navigational uses of international watercourses requires 35 countries to ratify in order to be in effect. There are currently 24 countries that have ratified this convention. Six out of these countries are in the south and east of the Mediterranean Region including Lebanon, Tunisia, Syria, Morocco, Libya, and Jordan if considered as a Mediterranean country. Some of the countries have reservation on some of the articles and principles of the convention such as the notion of a "watercourse" rather than a "river basin." Some of the countries that

ratified the conversion for transboundary waters do not have transboundary rivers, and some of the countries do not have rivers at all where these countries may not be affected one way or another by the ratification.

Helsinki rules, which used to govern the principles of transboundary water management, dealt with the "international drainage basin," as the "geographical area extending over two or more States determined by the watershed limits of the system of waters, including surface and underground waters, flowing into a common terminus." Equitable and reasonable utilization was based on water resources within the international drainage basin (AbuZeid 2001).

One can see the difference between adopting the watercourse approach rather than the river basin approach and the implications this may have especially on downstream countries that depend mainly on the blue water within the watercourse. This creates competition over the small portion of blue water that is often the main source for downstream countries, while ignoring green water that is the big share within a river basin and is often the main source for upstream countries. This is one of the reasons behind the reservation of some countries to ratify the convention.

5 Transboundary and Nonrenewable Groundwater

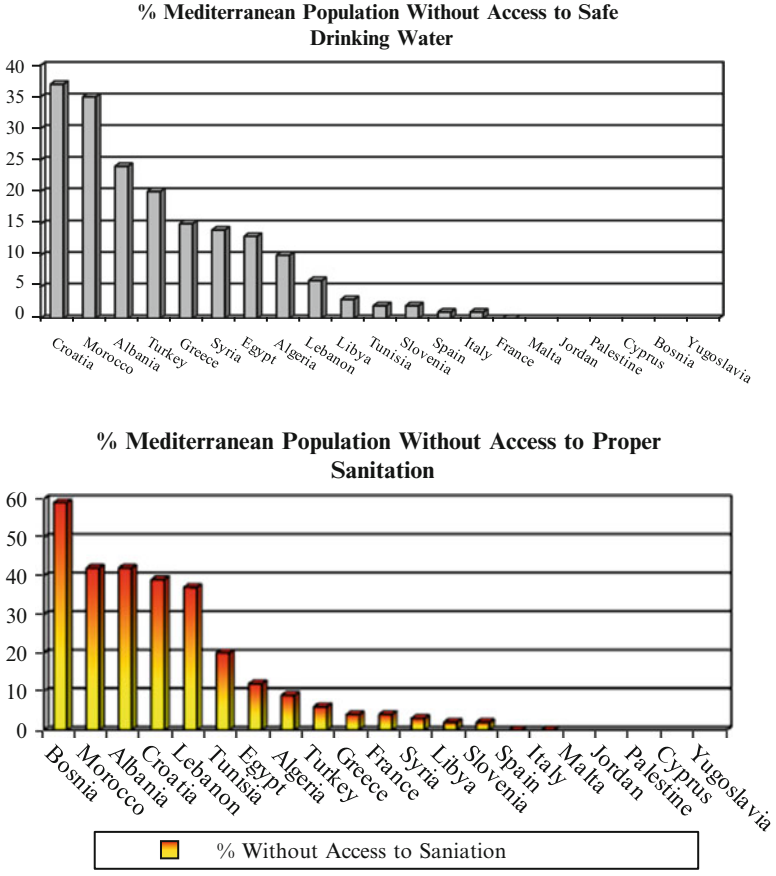
Most of the groundwater in southern part of the Mediterranean is nonrenewable, and in most cases, it is transboundary. Examples of this type of groundwater are found in the Nubian Sandstone Aquifers which are shared between Egypt, Libya, Sudan, and Chad. Petrified trees in the middle of the western desert in Egypt and isotope analysis indicate groundwater age of about 20,000 years which reflect that this groundwater is nonrenewable, and that the region used to receive rainfall in ancient times which resulted in the recharge of the Nubian Aquifer thousands of years ago (AbuZeid and ElRawady 2010). The south Mediterranean Region faces the double challenge of managing a groundwater resource that is transboundary and nonrenewable at the same time. This requires a future outlook that puts guidelines and policies for restricting use of this type of water to specific nonexploitable uses and regionally studied strategies whose implementation falls under continuous monitoring to avoid the rapid depletion of groundwater and negative developmental consequences.

6 Water Supply and Sanitation and the MDGs

One of the Millennium Development Goal targets is to reduce by half the percentage of people with no access to safe drinking water and improved sanitation by year 2015.

The graphs below show the year 2005 percentage of people without access to safe drinking water and improved sanitation in the Mediterranean. Rough estimates

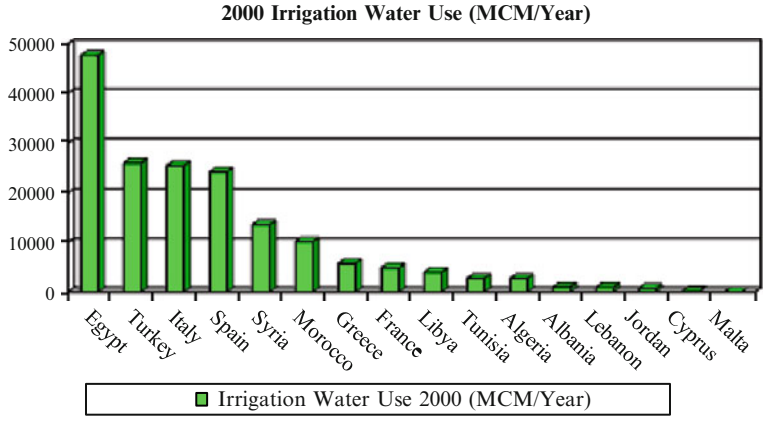
indicate the need for investment of at least 10 billion euros to achieve the water MDGs between year 2005 and 2015 in the Mediterranean. If achieved, this will still leave about 35 million people with no access to safe drinking water supply and improved sanitation (Arab Water Council and CEDARE 2007).

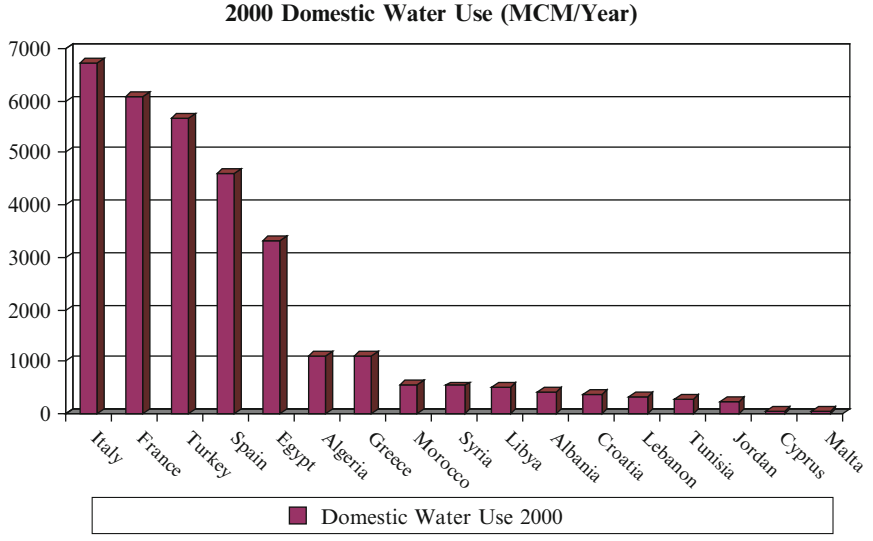


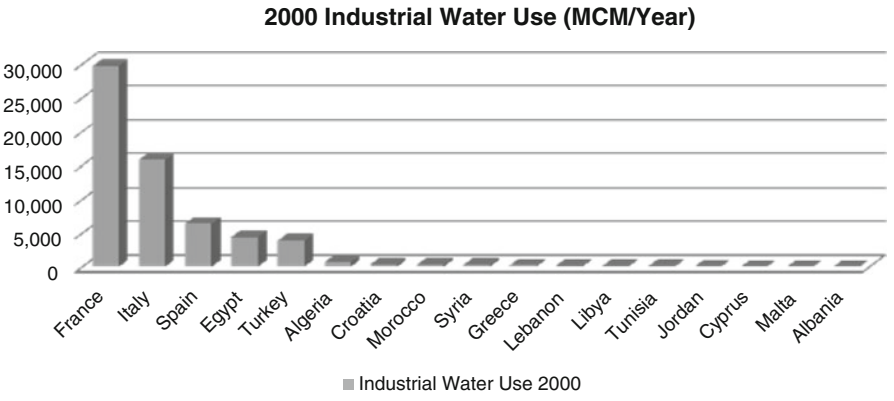
Even if the MDGs are achieved, the number of people without access to safe drinking water will increase. In the Arab Region which covers 22 countries including the 8 Arab Mediterranean countries, since 1990, 81 million people gained access to an improved drinking water source, but due to population growth, the number of people not using an improved source increased from 36 million in 1990 to 50 million in 2006. Since 1990, 89 million people in the 22 Arab States gained access to improved sanitation facilities; however, the number of people not using an improved facility increased from 90 million in 1990 to 96 million in 2006. Unless serious planning and investments are put in place, the outlook of water and sanitation services will be bleak for a large portion of the population.

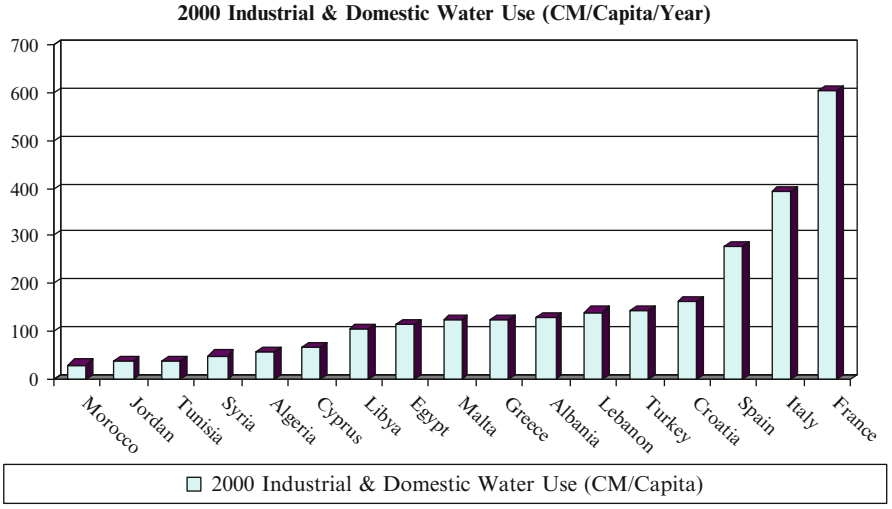
7 Water Demand Management Potential

The following graphs indicate the sectoral water withdrawals for irrigation, domestic, and industrial sectors in the Mediterranean countries as of year 2000. Although there is lack of updated data, however, the graphs indicate that demographics play an important role in assessing current and future outlooks of water at the national levels. Although a country may appear to be using large amount of waters, the per capita share of these water uses in that country may be at lower levels. The different indicators also show that water plays an important role in the development of a country and that developed countries often have larger per capita share of water withdrawals, especially for domestic and industrial sectors. The irrigation withdrawals by countries given below should not be used to reflect water consumption by the agriculture sector in those countries, because it only reflects blue water use in agriculture and not green water use, which may be larger, especially in north Mediterranean countries.









There is a potential for demand management and water savings in all withdrawal sectors, which will require certain interventions and investments. In the irrigation sector, indicated water demand management interventions may include land leveling, modern farm irrigation, canal lining, proper irrigation scheduling, low water consumption crops, improved drainage, and improved irrigation application efficiencies. These interventions through irrigation improvement projects may result in 10–15 % savings and sometimes even up to 30 % increased agricultural productivity.

There are 20–50 % losses in the water distribution systems in major Mediterranean cities. In the domestic sector, there are interventions to reduce consumption, some of which include installation of household water-saving devices which can save up to 15 % of domestic use, use of low-flow showerheads which can use less than 2.5 gallons

per minute, installation of toilet displacement devices which can save 4.2 gallon per day per device, installation of faucet aerators which can save up to 1.5 gallon per day per device, installation of metering devices which actual have proved to save from 15 to 40 % of household consumption, installation of high-efficiency washing machines which can save up to 37 %, and implementation of landscape water conservation programs which can save up to 20 % including the installation of moisture sensors and rain shutoff switches.

There are some interventions to conserve water in industrial and commercial sectors which may include installation of self-closing faucets which can save up to 50 %, ultra low flush (ULF) which uses less than 1.6 gallons per flush, and installation of low-flow valve urinals which can save up to 33 %. In addition, measures of Clean Development Mechanisms (CDM) can also add to the industrial water savings.

If all of these potentials in the different water sectors are summed up and added to the potential of recycling and reuse, the potential for water savings in the Mediterranean will include:

- 10 % of the total irrigation water use
- 15 % of the total domestic water use household water-saving devices
- 20 % of the total domestic water use for metering
- 37 % of 2 % of domestic water use for high-efficiency washing machines
- 20 % of 5 % of domestic water use for landscape irrigation conservation programs
- 25 % of 5 % of the industrial and commercial water use (self-closing faucets, low-flush toilets, and low-flow urinals)
- Reuse of 80 % of domestic and industrial/commercial water use, after deducting their freshwater savings

The potential for water savings in the Mediterranean can reach up to 94 BCM/year, where Potential Irrigation Savings can reach up to 17 BCM/year, and Potential Domestic Water Savings can reach up to 10.25 billion cubic meters (BCM) divided as 3.3 BCM from household devices, 6.4 BCM from metering devices, 0.18 BCM from high-efficiency washing machines, and 0.3 BCM from landscape water conservation programs, whereas Potential Industrial and Commercial Water Savings can reach up to 0.8 BCM/year as minimum, since there could be other CDM interventions that can provide additional savings.

On the other hand, potential savings by using treated wastewater can reach up to 66 BCM/year.

There are costs associated with water demand management. In the irrigation sector, the irrigated land in the Mediterranean Region is about 42 million acres. The cost for implementing irrigation improvement programs is about 700 euros/acre. Investment cost for irrigation water savings of 17 BCM/year is about 29 billion euros. Investment costs for domestic water saving of 10 BCM/year will be about 27 billion euros. Investment costs for industrial and commercial savings of 0.8 BCM/year will be about 0.8 billion euros. Without accounting for the cost needed to fill the water supply and sanitation coverage gab, investment costs for treated wastewater of 66 BCM/year could reach up to 50 billion euros (AbuZeid 2003).

8 Regional Water Strategies Governing the Mediterranean Region

There are three main regional strategies that are governing water management in the Mediterranean: the *Arab Water Security Strategy* (for 22 Arab Countries under the League of Arab States), the *Mediterranean Water Strategy* (for member countries under the Union for the Mediterranean) which still needs to be approved, and the *European Water Framework Directive* (for European Union countries).

In addition, there are national plans, policies, and strategies in the Mediterranean Arab Countries which govern water management at the national level. Some of these frameworks may qualify to be considered as Integrated Water Resources Management (IWRM) plans. Integrated Water Resources Management (IWRM) is the systematic cross-sectoral process for the sustainable development of water resources to maximize the social, economic, and environmental benefits from its efficient use.

The Arab Water Council and CEDARE have compiled a list of these existing IWRM plans (Arab Water Council, CEDARE, and UNDP 2004).

9 Conclusions and Recommendations

Potential water savings in the Mediterranean Region is 94 BCM/year, 18 BCM of which are from savings in the southern and eastern Mediterranean countries, and 76 BCM could come from northern Mediterranean countries. These savings are 11 % domestic, 1 % industrial, 18 % irrigation, and 70 % from recycling and treated wastewater reuse. 94 BCM in the Mediterranean can contribute to annual wheat grain demand of 68 % of the Mediterranean population estimated at 280 million people.

Average water demand management investment cost is 1.7 euro/m^3 for savings in irrigation water, 2.7 euro/m^3 in domestic water use, 1.0 euro/m^3 for savings in industrial/commercial, and 0.8 euro/m^3 for recycled and treated wastewater reuse.

Water demand management options should be embraced prior to desalination options. More investment should be directed to sewage collection, treatment, and reuse for environment and food security in the Mediterranean Region. Synergies are needed between regional water strategies covering the Arab Mediterranean countries.

Green water contributes more to food production in north Mediterranean while blue water contributes more to food production in south and east (Arab) Mediterranean countries. More attention needs to be given to green water in water resources assessment and in future planning. Amendment of the 1997 UN Convention on the Non-Navigational Transboundary Watercourses is needed to embrace the river basin approach rather than the watercourse approach to receive wider acceptance.

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