Middle East Water Crises

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I. *Introduction*

1. Climate

Semi arid and desert climates prevail in most parts of the Middle East. Only narrow strips overlooking the Mediterranean sea are blessed by Mediterranean climate. Continent-ward a narrow strip of 100 - 400km in width is affected by semi-arid conditions. This strip is then followed by extended dry deserts.

Generally, the average temperatures range in winter from 10-30 C and increase to more than 30 C during summer. In areas like Iraq, Saudi Arabia,the Gulf and North Africa it even reaches 50 C during day time, whereas during the winter season temperatures fall below the freezing point even in the desert areas.

The northern areas of the Middle East along the coast of the Mediterranean receive cold fronts during the winter months causing precipitation over the coastal areas and the nearby mountain chains.

The amount of precipitation attenuates very rapidly landward of the mountain chains, and generally its effects are negligible in a distance of some 50km.

On average, 90% of the area of the Middle East may be considered as arid and semi-arid and only about 6% receives an average amount of precipitation exeeding 300mm/yr. This is the minimum amount needed to produce wheat in dry farming areas.

2. *Water and man in the history of the Middle East*

A major characteristics of the Middle East is its aridity with short rainy seasons and high evaporation rates. water with only few exeptions, is scarce and precious. Therafore, it is not surprising that water and irrigation engineering had their birth and beginning in the middle East. In Mesopotamia, water of both the Euphrates and the Tigris Rivers was utilized for land irrigation initiating irrigation techniques and construction of irrigation canals; in Egypt, the Nile water was harnessed for irrigation, thus initiating and promoting Egyptian engineering and land surveying. In Jordan, where 90% of the country is semi arid and devoid of any perennial water sources, man was obliged to develop special techniques to survive during most of the seasons. Several exampels of constructions related to water utilization are well preserved in Jordan. The oldest known dam in the world stands in Jawa in the northeastern part of the country as a witness of the need to collect water; it is 5.5m in height and around 3200 years old. Another impressive exampel, is the

water supply of Petra, 2000years old, where a spring in Wadi-Musa village was diverted to the city through a system consisting of inter-connected network of ceramic pipes hanging 4-6 meters above ground on the side rocks serving drinking purposes. An open channel was also constructed to serve other uses.

In Yemen, Ma'arib dam is a historic legend of technological development.

The above mentioned exampels illustrate the ingenious measures inhabitants of the area has developed to assure their survival throughout the course of history. Forced by necessity, technicians of all civilizations worked to develop the hydrotechnical infrastructure without which none of the ancient empires could have developed or survived.

3. *Water Resources and Water Use*.

The water resources and water use in the area are given in Table 1, which illustrates that Jordan, Saudi-Arabia, Egypt, Palestine and Israel are totally using their water resources, and that these countries are not able to develop any additional increase in these resources.

Table 1 : Water Resources and Water Use in the Middle East Countries

Country	Available water MCM/yr	Used water MCM/yr
Jordan	900	780
Egypt	64000	63500
Saudi-Arabia	2200	2200
Syria	25000**	7000
Irak	60000**	46000
Lebanon	4800	1200
Palestine	230	250
Israel	2050	2150

** Historic flows of Euphrates and Tigris

Irak, Syria and Lebanon are still able to develop additional resources provided that these resources will continue to be available.

The poverty water amount is defined here as the amount of water needed, under the prevailing conditions to cover the domestic and irrigation needs per capita. Table 2 shows the poverty water amount for the Middle East countries. It clearly shows that Jordan,Saudi-Arabia, Egypt, Palestine and Israel are way below the water poverty limit, wheras, Lebanon is beyond it.

Both Syria and Irak are also beyond the water poverty limit at present and this will remain so, only as long as the historic flows of Euphrates and Tigris continue at the same rate.

Table 2: Water amounts required to cover the demand for domestic uses and food production per capita and year and the available percentage of these amounts.

Country	Water poverty line m^3/yr per capita	Percentage of present coverage
Jordan	1480	19%
Syria	1430	330%*
Irak	1100	465%*
Egypt	2500	45%
Saudi-Arabia	1100	17%
Lebanon	1300	130%
Palestine	1300	30%**
Israel	1200	40%

* Historic flows of Euphrates and Tigris Rivers are used.

** Resources are partly used Israel.

Any increase in population will ultimately result in complicating the situation and reducing the percentage water coverage in the area.

The water shortage in the area may also be illustrated on the example of a comparison of domestic water use. Table 3 shows the domestic water uses of different country groups, clearly demonstrating the unavailability of resources.

Table 3: Domestic water consumption in different areas and countries

Beduins in desert areas	4-5	l/c.d
Jordanians	85	"
Arabs (without oil)	125	"
Arabs (with oil)	280	"
Israelis	275	"
Europians	250-350	"
North Americans	500-600	"

The water shortage is also expressed in the domestic water use pattern of the inhabitants as illustrated in Table 4.

Table (4): Domestic water use pattern (l/c.d.)

Countries	Bathing	Closet	Washing	Drinking & Cooking	Garden Irrig-ation	Others: car wash, swimming
Arab: Oil producing	43	62	45	15	60	25
Arab: Non-oil prod.	26	39	33	15	8	9
Western	65	85	42	10	38	10

These numbers show that the luxurative uses of garden irrigation, car washing, swimming .....etc. are very small to negligible in non-oil producing countries which reflects the non-availability of water resources.

They also show that uses which affect the health and sanitation situation like bathing, washing and closet flushing are very small and may negatively reflect on the public health.

4. *Food Production*

Food production in the Middle East depends on irrigated agriculture with the exception of narrow coastal strips where rainfed agriculture is practiced.

Under the prevailing climatic environments where food production depends on irrigated agriculture the per capita food needs can be covered by irrigating 1000-1500 m^2 of land. The extent of the area depends on the technologies used in production. It needs, a minimum of 1000 m^3 0f water going up to 2500m3 of water at maximum, depending on the use efficiency.

High efficiency is achieved in rich countries which are able to invest in advanced irrigation technologies, and low efficiencies are prevalent in poor countries.

Food production in the Middle East is suffering a chronical shortage (Table 5). Table 6 shows the percentage of food imports to food consumption at present and as expected by the year 2000, if living standards remain as they are at present and if the producing areas are maximised by using all the available water resources and the most advanced technologies.

Table 5: Deficiency in food production 1990

	% of imports to consumption
Wheat	52
Rice	20
Barley	20
Vegetable	70
Tea	100
Coffee	96
Sugar	75
Butter	55
Meat (white)	35
Meat	12

Table 6: Percentage of food imports to food consumption (US$).

	At present	Expected in 2000
Jordan	62%	80%
Egypt	20%	25%
Saudi-Arabia	65%	87%
Syria	19%	23%
Irak	30%	41%
Lebanon	35%	45%

Table 7 shows the areas of producing land at present and as expected in the year 2000, when maximixing the technologies used in production.

Table 7: Irrigated land areas used at present and the maximised areas when using advanced production technologies (limiting factor being water resources).

Country	Producing land (x1000=hectar)	Maximum producing area using advanced technologies (x1000=hectar)
Jordan	3.5	3.8
Egypt	41.4	55.8
Saudi-Arabia	4.76	5.2
Syria	49.0	55.0
Irak	40.0	53.8
Lebanon	2.4	2.4
Palestine	1.92	2.74

Table 8 shows the cost of food imports per capita at present.

Table 8: Cost of food imports
($US/capita & yr.)

Jordan	110
Egypt	40
Saudi-Arabia	155
Syria	40
Irak	40
Lebanon	65

The previous exposition illustrate that the Middle East countries are amongst the countries of the world which are suffering from the largest food deficit. Hence, developing the agricultural sector is one of the main concerns of the area. But the potential for such development lies in irrigated agriculture, and here water availability is a basic requirement. Looking ahead, in about 20 years, all the Middle East countries have to, at least, double the domestic water supply, and if the present ratio of food stuff production to food stuff imports is to be maintained, the Middle East countries will have also to more than double the size of the irrigated areas. But, as explained above only Lebanon and, conditionally Irak can do that.

Egypt, Syria, Jordan, the Arabian Peninsula, Palestine and Israel will not be able to double their food production in 22-25 years. Contrary to that, the increased domestic water demand will most probably be covered by deducing it from irrigational uses.

II. *THE JORDAN RIVER SYSTEM*

1. *Resources and Projects:*

The headwaters of the Jordan River originate from three main springs; Hasbani, in lebanon; Dan, in Israel and Banias in Syrian territory occupied by Israel (Fig.1).

These three streams join in Israel to form the Upper Jordan River. The surface catchments of the three springs do not alone account for the large quantities of water discharged from them. Therefore, their underground watershed must extend further to the north, northeast and eventually northwest beyond the surface catchments and into Syria and Lebanon.

The Upper Jordan River once flowed into lake Hula, where more water joined the river course. In the 1950's,however, Lake Hula and the surroundings were drained and dried; since then the water has flowed through the so-called Hula Valley joining lake Tiberias further to the south.

Downstream of Tiberias, the onset of the Lower Jordan, different streams join the main river course. The biggest of these are the Yarmouk and the Zerka Rivers which join the Lower Jordan from its eastern side; The Yarmouk flows from Jordan's borders with Syria and the Occupied Territories,while the Zerka River lies within Jordan. The Jordan River then flows into the exitless Dead Sea.

The total discharge of the Jordan into the Dead Sea, prior to the implementation of the different water projects in Jordan, Syria and Israel was 1370 MCM/yr. This amount has now declined to mere 250 - 300 MCM/yr mostly as irrigation return flow, inter-catchment runoffs or saline spring discharges.

Israel uses all the water of the Upper Jordan (a net total of 650 MCM/yr), so that no fresh water flows downstream of lake Tiberias from the Upper into the Lower Jordan River.

Saline springs in the immediate surroundings of Lake Tiberias and at its bottom are channeled downstream of Tiberias into the headwaters of the Lower Jordan River.

The discharge of the Yarmouk River into the Jordan River was, around 400MCM/yr prior to the use of the water by the different riparians. In the last few years this amount has gradually declined to very small discharges only as a result of large floods which cannot be accommodated by the existing extraction facilities.

The other wadis and springs on both sides of the Jordan Valley are dammed or captured by constructions. That remains-- runoffs due to rains over areas downstream of water collection constructions, return flows or saltwater discharges-- then joins the river.

From the Yarmouk River, Syria extracts 160 - 170, Jordan 100 -110 and Israel around 100 MCM/yr.

2. *Sharing of Water and Recent History:*

In the case of the Jordan River system, there are no valid agreements pertaining to sharing the jointly-owned water resources. An agreement was signed between Syria and Jordan in 1953 regarding water allocation of the Yarmouk River, providing for the construction of a dam on the Yarmouk River, and the subsequent division of water resources at a ratio of about 1:3 between Syria and Jordan, respectively. Revisions were made in 1987, and according to the new agreement, Jordan was supposed to construct the Unity dam on the Yarmouk River, designed to collect 180 - 200 MCM/yr of water for its own use.

Because of water scarcity in the Jordan area, a very small river like the Jordan represents a vital source of water for its riparian states. Plans to develop water resources go back to the 1940s and 1950s when the different countries developed individual plans for water utilization. The disperities found among these plans led President Eisenhower to send a special envoy, Eric Johnston, to the area in 1953 to design a comprehensive proposal for sharing the Jordan River water. After two years of negotiations, Johnston offered a plan which was accepted by both the Arabs and the Israeli technical committees,but the Arab League refused to ratify the plan for political reasons.

According to that plan, the Upper Jordan and the Yarmouk waters were to be shared as follows:

Johnston plan allocations MCM/yr.

	Syria	Lebanon	Jordan	Israel
Jordan River	42	35	100	(375) the rest*
Yarmouk River	90	00	377 (the rest)	25 Yarmouk** Triangle

*The rest: What remains in the river after extracting the fixed shares.
**The Yarmouk Triangle: Water allocated for irrigating the Yarmouk triangle between the Jordan River, the Yarmouk River and Lake Tiberias.

At present Jordan takes only 100 - 110 MCM/yr from the Yarmouk River and no water from the Jordan River. Syria takes 160 - 170 MCM/yr from the Yarmouk and nothing from the Upper Jordan. Lebanon takes nothing from the Jordan River, while Israel takes 650 MCM/yr from the Jordan and around 100 MCM/yr from the Yarmouk.

By comparison Jordan is the biggest loser and Israel is the biggest winner.

3. *Socioeconomic Importance and Political Implications of Water Resources and Uses.*

The Jordan River riparians-- Syria, Jordan, Lebanon and Israel are in an official state of war with each other. The Jordan River constitutes a major source of fresh water for Israel and Jordan (including the West Bank), both of whom are currently facing and are expected to continue facing severe water shortages in the next decade.

With a population growth rate of 3.6% per year, Jordan will have to double its current annual domestic water supply by the year 2000 to meet its growing demand.

As a result of the Gulf war, Jordan received around 300,000 Jordanian and Palestinian returnees from Kuwait and the other Gulf states and around 100,000 Iraqis, increasing the population of the country by 13% within a few months. This migration put a great deal of pressure on the country's already severe drinking water supply situation, especially during the dry season.

Early in 1991 , around 3000 ha of irrigated land were damaged in Jordan, when water shortages forced farmers to use bad-quality water for irrigation. In September of the same year, the Ministry of Water and Irrigation asked farmers in the southern Jordan Valley to cultivate only a quarter of their lands, because of water shortages and the government's inability to provide more water.

The citizens of the major urbanization centers in Jordan, suffered this year from a catastrophic water shortage; water was pumped only once or twice a week through the networks, then collected and stored in roof tanks for use during the following week or so, almost every one was living at the hygiene brink, where water use was concerned.

Israel is also suffering from diminishing water resources, although it obtains around 1/3 of of consumed water from the Jordan River and another 1/3 from the West Bank and Gaza Strip.

In 1991, water in lake Tiberias dropped to its lowest ever recorded levels, and Israel's Water Authority was considering emergency measures to restrict, pumping to prevent the water level from dropping below the danger point of 212.5 meters below sea level. For the last five years, Israel has been rationing water-- mostly affecting the politically sensitive farming sector which consumes around 75% of the country's water supply.

The expected arrival of 250,000 and 300,000 Soviet Jewish immigrants within the next few years will certainly put more pressure on the Israel Water Works to supply sufficient water. The required amounts have either to come from water resources located outside the country,or from sea water desalinization or they will be reallocated from agricultural uses.

Syria still have other resources to develop, and does not depend on the Jordan River system for any vital irreplaceable uses.

Lebanon has large quantities of surface and groundwater at its disposal, so the water resources of the Jordan River are of very Little importance for this country.

4. *Environmental Impacts*

Using the Jordan River's system water for the different purposes has led to a drastic decrease in the amount of water reaching the Dead Sea-- from about 1900 MCM/yr from the different sources to about 550 MCM/yr at present. With the prevailing evaporation rates, the level of the Dead Sea has gradually fallen from 392 m to 407m below sea level over the last 27 years. In the last few years the annual drop has averaged 85 cm. This decline in sea level is accompanied by a seaward salt /fresh water interface movement, and hence a general drop in fresh groundwater levels which are in hydrodynamic equilibrium with Dead Sea water(Fig.2)

One proposed solution to the declining Dead Sea level is the proposed connection to either the Mediterranean Sea or the Red Sea via a canal or tunnel; the transfer of water would raise the level of the Dead Sea again and sustain it at a certain elevation. The accelerated water flow resulting from the differences between the levels of the Mediterranean Sea or Red Sea and Dead Sea could be utilized in hydropower production.

The irrigated soils along the Jordan Valley are currently showing the first signs of salinization, a situation which has occured repeatedly throughout history.

For the last four millennia, inhabitants of the area has developed their water resources and irrigated their land. Irrigated areas extended further and further, and the unit land was allocated less and less water; unbeknownst to the farmers, salt accumulated in the soils, gradually decreasing productivity to a point where the land has to be abandoned, forcing the population to move elsewhere, to more fertile and water-rich areas. Decades later, rainfall and floods would flush the soils, and the cycle would start again.

Nowadays, tests and experiments can predict these events. Soil salinization is becoming more common, and can only be halted by reducing the total irrigated area, giving the remaining area enough water to meet plant needs and soil flushing requirements.

A series of dry years caused by reasons such as global warming can accelerate the environmental impact, including rapid drops in Dead Sea and fresh groundwater levels, and increased soil salinization.

5. *Future Prospect*

Jordan, Palestine (West Bank and Gaza) and Israel are presently overexploiting their water resources by 15% and 20%, and 10%, respectively.

Generally, water levels are dropping, fossil water resources are being mined, salinization of aquifers is taking place, salt water intrusions can hardly be avoided, irrigated soils are showing salinization phenomena and the domestic water supply of the population does not satisfy the hygienic and living standards demands.

As a conclusion; the area is experiencing an escalating water crisis; The water shortages are already chronic.

Various measures might be considered to alleviate or eliminate the water shortage:

Importing water from water-rich countries like Turkey, through the proposed "Peace Pipeline," which would channel water from the Ceyhan and Sayhan Rivers in two pipes--one running through Iraq to the Gulf States and Saudi Arabia and the other through Syria to Jordan, Palestine and Saudi-Arabia. (Although this project is considered as a supplement to existing water supplies it should be considered very seriously whether such a vital commodity can, for such a large area, be controlled by one country--especially one like Turkey, which has been alternatively rival, friend and enemy to others in the area.

- Desalination of sea water, though expensive, could alleviate the problems of coastal communities.Due to its high cost, Desalination could be justified for drinking purposes, but not for irrigation uses--regardless of the products.

- Curtailing irrigated agriculture even further might increase domestic water supplies and alleviate the shortages, but such a measure would result in declining food production and foodstuff coverage, lower export revenues, higher hard currency exspenditures for food imports, and higher unemployment-- with all its socio-economic ramifications in the different countries. Curtailing irrigated agriculture must therfore be coupled with a transfer to industrialization, to guarantee jobs and revenues and to stabilize the social and political systems. Such restructuring--from an agrarian to an industrialized economy--would require large investments of time and money, as well as a great deal of skilled planning, training and technological expertise.

III. *Middle East Water Resources as Compared to the World's Water Resources.*

The annual per capita share on renewable, nonrenewable, treated and desalinated water in the Middle East countries is around 1400 m^3/yr. Taking the population growth into account, this amount is expected to decrease to 1050 m^3/yr by the year 2000, that is if the upper riparians of the major rivers do not develop and use these rivers. But if they do develop what they consider as their share in these waters the annual per capita amount will drop by the year 2000 to 1000 m^3/yr.

From the figures given above, one can recognize the severe water shortage of the Middle East countries and imagine its implications on other life aspects. But, the water problem in the Middle East is not merely a shortage problem, maldistribution in time and space and the inability to completely develop all resources, also add to and aggravate the water shortage problem.

If advanced technologies are used, the extraction and utilization of water can go up to 80% of the available resources, which would make the per capita annual obtainable share of the Middle East inhabitants by the year 2000 amounts to 800 m^3/yr.

This amount, if properly used and distributed would only be enough to cover domestic uses and around 50% of food production water requirements.

As a general conclusion for the Middle East countries water resources as compared to the World water resources, the following can be stated:

- The Middle East countries have at their disposal only about 0.4% of the world water resources, although, the Middle East land makes around 4.5% of the world area and its population is around 2.5% of the world population.

- With their population, the Middle East countries can at present only produce around one half of their food needs with water availability as being the main limiting factor of production.

The natural environment of the Middle East can, at present, only sustain half the population of the area which would mean that other sources must compensate for the water scarcity.

The sources, partly compensating for shortage, at present are oil and gas which are but nonrenewable and limited.

The water resources of the Middle East are unevenly distributed which makes their exploitation and use under the prevailing political circumstances very difficult.

VI- *Discussion and Conclusions:*

1. *Resources and recent developments*

The surface waters of the Middle East have two origins; internal sources which result from precipitation falling over its territories, and external sources which flow into the Middle East from rain-rich areas lying further to the north; Turkey or further to the south; Ethiopian Plateau. The external sources account for about 75% of all surface water resources of the Middle East. These resources are mainly, the Nile, Euphrates and Tigris rivers in addition to other smaller streams.

In the fourties and fifties of this century the different Middle East countries started to develop their water resources for the different uses. In the sixties and seventies major water projects were carried out including dams and irrigation canals (Aswan High Dam, Thawra Dam, East Ghor Canal, the National Water Carrier .. etc.). In the eighties even marginal resources were developed to satisfy the increasing demand of the fast - growing countries. At present the main potential sources to increase water supply are non-conventional; wastewater treatment and reuse, desalination of sea water, mining of fossil water and development of deep groundwater and very minor, marginal, costly sources.

Gradually it was recognized by the different countries that water scarcity is a major concern and constraints in development and that the variable water resources represent a wealth for the owner countries.

The Middle East countries are also suffering from the largest food deficit in the world and hence developing the agricultural sector is one of the main concerns. But the potential for such development lies in irrigated agriculture, and here water availability is a basic requirement. Looking ahead, in about 20 years, all The Middle East countries have to, at least, double the domestic water supply, and if the present ratio of food stuff production to food stuff imports is to be maintained, the Middle East countries will have also to more than double the size of the irrigated areas. But, only few of these countries can do that. These countries are Sudan, Iraq, Lebanon and eventually Yemen.

Egypt, Syria, Jordan, Palestine the Arabian Peninsula and Israel will not be able to double their food production in 22 - 25 years. Contrary to that the increased domestic water demand will most probably be covered by deducing it from irrigational uses.

Nonetheless, there is a number of options which may have some potential for increasing the availability of water in the Middle East, like collection of storm water or water harvesting, reclamation of wastewater, conservation measures, introduction of

advanced irrigation technologies and cloud seeding. But these options have only a limited potential which may increase agricultural production by a maximum of around 50% if fully developed. The development requires introduction of techniques involving relatively big investment and training.

An increasing problem already causing tremendous concern to the Middle East countries is water pollution, which is not only leading to water quality deterioration but also to diminishing available resources by making these resources less suitable for their present uses, or of no use for any appropriate purpose.

The water resources on which cities rely are often polluted by enormous amounts of human wastes, sometimes channeled untreated into open water bodies. Other cities depend on resources that can not provide enough water for the increasing population forcing people to find other alternative unregulated courses of water which may not be of drinking water quality, hence leading to health problems.

Industries are also using large amounts of water for cooling, transport, cleaning, processing... etc. Once used, these waters suffer significant quality degradation. The wastewater is then discharged into rivers, lakes, coastal waters and along dry wadis, causing the environment to degrade due to the reduced quantity of water available for high standard uses, and due to deteriorating surface and groundwater qualities.

Government funding for environmental protection is often unavailable or has a very unproper priority.

Regrettably, anti-pollution rules in the Middle East are either unavailable or very vague. Even if they exist they can easily be circumvented. New rules must be found to account for the prevention and repair of environmental damages.

Wastewater treatment and reuse are still in their infacy in most Middle East countries, inspite of their importance in this part of the world rather than in water rich areas. If present conditions and ways of waste production and dumping continues, soon, most Middle East countries will be shocked by environmental disasters. Signs of such are now found along the Nile downstream of Cairo, along the Tigris downstream of Baghdad and along the coasts of the Gulf and Mediterranean Sea.

Some of the Middle East countries are also depleting their water resources stored in desert aquifers since ancient times by mining these resources for wheat production. Most of these countries are rich, possessing large oil revenues and are not in need to produce wheat and to exhaust the precious water resources which are elsewhere considered as a strategic reserve.

In the case of fossil water mining for irrigational uses the water resources development policies are not taking environmental factors into consideration which may discourage actions promoting

immediate short - term gains at the expense of the creation of irreversible conditions and imbalances in natural systems.

2. *Riparian Issues*

The upper riparians of the Euphrates, Tigris, Jordan and probably the Nile rivers are developing these international water resources to be utilized in irrigation, hydropower production and other uses without sharing agreements with the downstream riparians and without due considerations to other riparians water rights or historic uses. Such actions by upper riparians may cause great injuries to the water, not only in quantitative but also in qualitative terms making the water only suitable for restricted uses.

No valid agreements among all riparians of a certain water system in the area exist, although water rights in these same arid areas, contrary to water rich areas, predated land rights.

3. *Probable Effects of Climatic Changes:*

Climatic changes which result in declining precipitation might cause surface and ground water resources to deplete. This can lead to the inability to provide water at the present rate for the different purposes. Hence, agricultural production is expected to decrease not only because of the diminishing irrigation water but also because of the expected contraction and decline of rainfed zones which will result in a decline of dry-farming-land areas.

Less irrigated land and less food production from dry farming might result in increasing unemployment and larger imports of foodstuff. Both results have their socio-economic implications, the least of which is social unrest.

Also declining precipitation may be tempting to upper riparians to keep and use the jointly owned water resources by themselves which can fuel disputes and conflicts. Such circumstances represent a triggerer for armistice conflicts if not managed in a fair equitable way.

Declining precipitation can also negatively affect soil qualities by increasing salinity and changing the soil structure. Desertification intensities may increase and more lands may be desertified and abundend.

Declining precipitation is also expected to accelerate the drying up and drop in the level of the Dead Sea, a unique feature and natural resort of the Globe.

Desert oases and playas are expected to contract in extension and the time periods of them containing water to shorten, or they even may dry out.

All these implications have their far-reaching environmental impacts on the vulnerable, delicate, sensitive equilibria of desert life and ecology.

4. *Management*

By now it is clear that the increasing demand for fresh water cannot be met from the present water resources of most Middle East countries. Managerial actions can alleviate the water shortage problems. But, management of scarce resources implies setting up of use priorities and strategies to make the best use of resources. Merely to characterize the water sector problems does not solve these problems. Technical, pricing, regulatory actions are clearly required to alleviate the problems and to help the water sector to further supply the countries with adequate resources.

Water management and planning in the water-poor Middle East will always be difficult owing to the complexities inherent in water issues including the socio-cultural factors of people's manner of living, their lifestyles, customs, agricultural and economic habits, scientific and technological approaches to resolving water problems.

Socio-cultural conditions and the psychology of the people have to be given high consideration in any attempt to solve the water problems in the Middle East. New methods difficult to familiarize with may be rejected and hence have a high probability of failure. Management of scarce resources with the complicated socio-cultural and socio-economic conditions prevailing in the Middle East countries is also affected with lack of certainty which result from the human, physical, climatic, political and economic conditions and events. The management of Middle East water resources has not developed on the basis of socio-cultural and socio-economic circumstances. It is still inbetween a nomadic, simple way of management and a western management. One time emphasizing the first and another the second without interweaving both to overcome obstacles and to move ahead into the future.

It is now also clear that the water problem, in the future will not be, whether water ia available at a certain site, but rather whether it can be obtained at a price to justify its use.

Subsidies of irrigated agricultural products must be reconsidered. Many projects which utilize huge amounts of water, especially those established on fossil water resources are subsidized by the concerned governments although they add very little value to the production of the societies. These are the first water uses to be abundend because the environment cannot sustain their presence for long.

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