

Middle East Water Issues: Nine Lessons Toward Peace

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OVERVIEW

In this unit I will be focusing on the role the environment plays in political struggles between nations. I have chosen the Middle East because this area of the world has had dramatic events surrounding each nation's need for water and land that has water resources under it. The drama of this long and often warring conflict has not escaped the notice of many students and their parents. I'm sure there will be quite a bit of prejudice involved in student's views of the issues in the Middle East, and I hope to redirect religious and political prejudice to a more scientific objective approach to the events we'll be studying. Personally, I think the only solution to the diminishing water supply in the Middle East lies in cooperation based on scientific research. Given the political tensions and prejudices among the countries involved, however, I am resolved that rule of law and strict enforcement will help assure fair allocation of the water supplies among the parties involved. Furthermore, as there is a great difference between the standard of living of Israel and her neighbors, efforts need to be made to help Arab countries technologically maintain their infrastructure with respect to water facilities. In that way they won't have to rely on Israel's good will to manage their fair share of the water resources.

Middle Eastern conflicts are complicated ones, which many children may be aware of because of their religious background or because of their cultural heritage. Water conflicts are at the basis of much of the contention between Israel and its neighbors both historically and recently. These conflicts are the underlying cause of much of the contention between nations and have an important part in determining the cultural bias of the people in this region. It is important, I think, to let the children know that these disagreements aren't only based on religious differences, but have roots tied closely to the land and its ability to support the people on it. I also believe that study of these issues needs to be as unbiased as possible so that the class can be free to determine its own ideas and solutions to problems. Therefore, although I have raised several controversial issues, it is my intention that conclusions be drawn by students in an atmosphere of open questioning and debate based on facts.

A HISTORY OF PROBLEMS

Water, considered by all holy books as a divine gift to mankind, is a ubiquitous resource, vital for life, human wellbeing, and economic development, and thus vital for peace and security. Fresh water is substantially decreasing in quality and quantity throughout the world, so much so that the issue of water is similar to that of oil in the early 1970s. As a result, fresh water will be the focus of intense political disputes in the coming decade and will become the natural resource most likely to cause armed conflicts in the twenty-first

century. New sources of fresh water are decreasing in availability because 95 percent of the world's sewage is dumped directly into rivers, and the cost of tapping new water supplies is two to three times higher than tapping existing supplies. Thus, chronic water shortages will plague approximately 40 percent of the world's population in approximately 80 countries by the end of 1996.

The alarming increase in the global population, accompanied by a doubling in the growth of the world-wide demand for water, raises major concerns and tensions among states, particularly Middle Eastern countries, which suffer from scarcity of this resource. Since ancient times, the need for fresh water has played a prominent role in shaping Middle Eastern civilizations.

In ancient Egypt, the population gathered around the Nile, and in Mesopotamia, around the Tigris and the Euphrates. Following the collapse of the Ottoman empire, the location of water resources, particularly the Jordan River, had an important influence in shaping boundaries outlined in the French and British mandates which later became the borders between Lebanon, Syria, and Jordan. Each of these river basins has had its share of conflict, however we will be concentrating on the Jordan River and its influence on the states of Lebanon, Syria, Jordan and the newcomer, Israel.

In 1949, Armistice Agreements that were established after the first Arab-Israeli war set new boundaries and Demilitarized Zones between these neighboring states. Due to differing interpretations of the legal status of these zones, the Middle East witnessed recurrent hostilities and retaliatory incidents between its states. The Jordan River played a crucial and strategic role in these hostilities.

During the 1950s, the United States' Cold War policy forced the United States to play an active role in shaping Middle Eastern politics. Thus we found ourselves having a significant influence on the water problems between the riparian enemy states. Arab populations were suffering from serious poverty, lack of development, and especially hostile feelings toward the United States for its continuous and unconditional support of Israel. Because some believed that extreme poverty would breed pro-Communist feelings, American officials saw the need to ensure plans for the development of the region, including management of the water facilities in the Jordan River Basin.

Ultimately, a project to alleviate some of these tensions lead to the writing of the Unified or Main Plan, that was submitted to the United States Government and the United Nations Relief and Works Agency (UNRWA) in August 1953. The Main Plan suggested construction of diversionary canals to irrigate the lands of the Upper Jordan Basin. It also supported utilization of Lake Tiberias as a storage reservoir for the flood flows of the Jordan and Yarmouk Rivers. The Main Plan rejected some earlier proposals, such as the use of the Maqarin Dam for irrigation and made no reference to the Litani River in Lebanon.

President Dwight Eisenhower appointed Eric Johnston, then Chairman of the United States Technical Cooperation Agency's Advisory Board for International Development, as "Personal Representative of the President," with the rank of ambassador. Mr. Johnston's mission was to reach a regional agreement between the riparian states (Jordan, Israel, Lebanon, and Syria) on the development of the Jordan River Basin. He presented the Main Plan as a framework for regional cooperation on water resources, considering a framework based primarily on the needs and consumption of the neighboring states and their available resources, not the geographical borders separating them.

Negotiations with all the parties were successful. The allocations set forth by the Main Plan were ultimately accepted by both Arab and Israeli technical committees. However, the Main Plan remained unratified for political reasons. The political environment in the region was full of hatred, leading to serious misconceptions and continuous hostilities. In fact, the Arab League refused to recognize the plan because it would help the development and be an implicit recognition of the state of Israel. In the aftermath of Johnston's failed mission in the Middle East, the riparian states continued their unilateral water development projects.

Meanwhile, the two principal riparian states, Jordan and Israel, were tacitly conducting their water policies in accordance with the Main Plan. Although Main Plan negotiations never resulted in a formal international instrument, they impacted the policies of the two riparian states during the following years. Moreover, the informal understanding between Israel and Jordan ultimately led to discrete technical meetings to determine day-to-day hydraulic operations in the 1960s and 1970s. Water officials from Israel and Jordan met two to three times a year at "Picnic Table Talks" to discuss flow rates and allocations at the confluence of the Jordan and Yarmouk Rivers. Israel and Jordan began unilaterally acquiring what water they could. Jordan extended an irrigation canal (East Ghor Project) from the Yarmouk River southward along the eastern Ghor of the Jordan Valley. The East Ghor Project was carried out in cooperation with Syria and financed jointly by the governments of Jordan and the United States. Israel proceeded with a ten-year plan to integrate all of the country's water resources into a comprehensive countrywide network called the National Water Carrier.

These unilateral water development projects created serious tensions among the neighboring states and led to the exchange of threats between them. In response to Jordan's pleas before the Arab League, the Arab states had two possible responses: (1) diverting the Hasbani and Baniyas waters northward into Syria and Lebanon to obstruct their access to Israel; and/or (2) implementing military measures to deny Israel Upper Jordan water, thereby provoking a confrontation. Only Syria favored military action. Egypt's president, Abdul Nasser, urged his Arab partners not to fight Israel, having had assurances from President Kennedy that the United States would help to defend Israel. Israel responded that it intended to complete the project and to prevent the Arab countries from diverting the waters of the Jordan River. Between 1964 and 1967, these political clashes developed into several military confrontations between the Syrians and the

Israelis. Other than the bombing of the East Ghor Canal later in 1969, this time period involved the most direct water-related conflict. The most notable incident was the destruction of the diversion works on the Baniyas-Yarmouk Canal in Syria by the Israeli Air Force in July 1966. Israel destroyed the All-Arab diversion plan that would have reduced Israeli water supplies by 35 percent.

Finally these hostilities climaxed in the Six Days War of 1967. In the aftermath of the Six Days War of 1967, the geopolitical map of the Middle East changed dramatically. Apart from Israel's important victory in terms of land and borders, Israel also gained important water resources by acquiring two of three Jordan River headwaters, riparian access to the entire river, and the recharge zones of the mountain aquifer that currently supplies one-third of Israel's freshwater supply. By occupying the Syrian Golan Heights, Israel also controlled the Baniyas tributary. After its 1982 invasion of Lebanon, Israel maintained effective control over the remaining Hasbani tributary as well as the strategic Litani River. Some experts argue that the quest for water has been the primary motive behind Israel's wars, and that this motive has been prominent in Israel's military strategy and policy. Today, the control of these water supplies lies principally in Israel's hands and as Israel has been accused by Jordan, Palestine and Syria of restricting access to sufficient water during times of drought and as a weapon of retaliation regional conflicts.

A TREATY BETWEEN JORDAN AND ISRAEL

In 1994 Israel and Jordan agreed to a Treaty of Peace. This treaty is the best illustration of the importance of water to the people of the Jordan River Valley. Of the 36 provisions in the treaty, the provision in the Treaty governing shared natural resources is Article 6 of the Treaty, and is entitled simply "water." Article 6 of the Treaty constitutes the first water agreement between Israel and one of its neighbors. The following is a summary of Section 6 on "Water" from the Treaty of Peace, Oct. 26, 1994, Israel-Jordan, 34 I.L.M. 43 which may be found in its entirety at <http://www.en.monde-diplomatique.fr/focus/mideast/region-jordanie-94-en>

The first paragraph of Article 6 sets forth principles governing the "rightful allocation" of the different shared water resources between Israel and Jordan. The major water resources that are subject to the provisions of the agreement are as follows: Water of the Jordan River, with all its tributaries, consists of about 600 million cubic meters per year (mcm/year). The water of the Yarmouk River consist of approximately 500 mcm/year of which 250 mcm/year flowing south of Syria. The water of the Mountain Aquifer that extends from the mountains of the West Bank into pre-1967 Israel that consists of between 500 to 600 mcm/year. The treaty deals separately with the allocation of Yarmouk and Jordan waters. The treaty also creates a distinction between summer and winter allocation that did not exist in the Main Plan.

1. Waters from the Jordan River

The Treaty entitles Jordan to the majority of the Yarmouk River's flow and gives Israel principal entitlement to the Jordan waters. Jordan receives twenty mcm of summer flow in exchange for 20 mcm of winter Yarmouk water and must bear the cost of the transfer. During the winter period, Jordan is entitled to store for its use an average of 20 mcm from the floods of the Jordan River south of its confluence with the Yarmouk. The Treaty allows both states to use the excess flows in order to avoid unnecessary waste.

The Treaty also provides for Israel to maintain its use of the Jordan River waters between its confluence with the Yarmouk and its confluence with Tirat Zvi Wadi Yabis. Jordan has the same right but is only entitled to those waters if its entitlement is subject to the condition that its use does not "harm the quantity or quality of Israeli uses."

Under the Main Plan, Jordan was entitled to 100 mcm/year from the Jordan River waters that was to be transferred from the Kinneret to the East Ghor Canal. However, after the failure of the Main Plan, Jordan began taking this portion directly from the lower Jordan River bordering its territories.

2. Waters from the Yarmouk River

Under the Treaty, Israel is entitled to 25 mcm/year (12 mcm in the summer and 13 mcm in the winter), and Jordan gets the rest of the flow. Further, Israel is entitled to pump an additional twenty mcm from the Yarmouk in return for its concession of transferring twenty mcm during the summer period from the Upper Jordan River to Jordan. Finally, both countries are entitled to the excess floodwaters that are unusable. Under the Main Plan, Israel was allocated 25 mcm/year of the Yarmouk water. However, as mentioned earlier, the Main Plan did not have any seasonal distinctions. Although all of that water was a summer allocation, Israel regularly extracted extensive amounts of water during the winter seasons. While it never officially claimed any right to these waters, Israel used them when Jordan could not. In this way, Israel took advantage of its temporarily favorable geographic position and avoided the waste of unused waters. Undoubtedly, the agreed repatriation of the Yarmouk waters has resolved a "point of contention which arose on previous occasions." Under the Main Plan, Jordan was allocated 100 mcm of Yarmouk waters for the proposed West Ghor Canal on the West Bank, then under Jordan's control. The Six Days War of 1967, however, changed the Middle Eastern map and gave Israel control over the Yarmouk, granting Israel an arguable claim over the alleged 100 mcm/year that it had been extracting. This claim was disputed by the Jordanians and Syrians, who also shared the Yarmouk resources, but was resolved under the Treaty after Israel abandoned its claim in accordance with Israel's proposed withdrawal from the West Bank.

3. Saline Springs

Under the section covering the Jordan River, the Treaty contains provisions for desalinated water. Jordan is entitled to 10 mcm of desalinated water from about 20 mcm of saline springs diverted into the lower Jordan River. Israel agreed to “explore the possibility” of desalinating and maintaining the springs at its own cost. Furthermore, Israel will supply Jordan with the 10 mcm from the Jordan River during the summer period until the facilities are operational.

4. Groundwater

Annex II includes a separate article dealing exclusively with the groundwater in Emek Ha’arava/Wadi Araba. This article is an essential section of the Treaty because it governs wells that were once drilled and managed by Israel but currently fall within Jordan’s boundaries and thus are controlled by Jordan. The Treaty mandates that the wells remain in Jordan’s control but subject to both neighbors’ use. Jordan is responsible, with Israel’s support, for licensing well maintenance and replacement so that proper use is preserved by both states. Provisions also stipulate that both states have a duty to refrain from taking “any measure that may appreciably reduce the yields or quality of these wells and systems.” This article provides Israel with an additional 10 mcm/year from the wells. However, the additional allowance is subject to the supervision of the Joint Water Committee to assure that the increased pumping does not harm existing uses.

5. Operation and Maintenance

The Treaty contains several provisions concerning the operation and maintenance of almost all the agreed water resources. Systems located within Israeli territory, including those supplying Jordan with water and electricity, are Israel’s responsibility, while those serving only Jordan are Jordan’s responsibility and expense. Israel guarantees Jordanian personnel with equipment access to the facilities located in Israel in order to assure continued operation. In addition, Jordan is responsible for the operation of the wells in its own territory to assure Israel’s supply of water and electricity. Because Israel maintains responsibility for those wells, Jordan guarantees Israel access to personnel and equipment to facilitate the operations.

6. Additional Water

Article I of Annex II of the Treaty governs the development of additional water resources. In this section, parties agree to cooperate in finding new resources “for the supply to Jordan of an additional quantity of 50 mcm/year of water to drinkable standards.” Interestingly, this allocation of drinkable water comes as compensation for Jordan. Fifty to seventy mcm of the 100 mcm/year allocated to Jordan under the Main Plan were to be of drinkable quality and were to be diverted from the Kinneret into East Ghor Canal. However, under the Treaty, Jordan’s allocation is directly diverted from the

lower Jordan River, leaving Jordan with water of high salinity. Some experts argue that this compensatory allocation is “a peace gesture on Israel’s part” to help Jordan deal with its chronic shortage of drinkable water.

The Treaty of 1994 with Jordan however has not guaranteed peaceful relationships between Israel and her neighbors. Israel has not lived up to her agreements with Jordan in all cases. Israel has also had problems with Palestinians in the Gaza Strip and West Bank where it is clearly evident that Israel obtains far more of the available water than do Palestinians in both of these areas combined. Some of the problem lies in the way water is used by the different peoples. As the largest and by far the most prosperous of the three, Israel accounts for most of the consumption, the study confirmed. At 344 cubic meters, its per capita water use in 1994 was almost four times that of the West Bank and the Gaza Strip, at 93 cubic meters a person. Palestinian officials and Israeli environmentalists often point critically to this disparity and to California-style watered lawns and capacious bathtubs that they consider irresponsibly profligate. Yet the study showed that Israel's use is only marginally greater than Jordan's use. Jordan is poorer than the West Bank, yet consumed 244 cubic meters a person. In Jordan and Israel, the thirstiest consumers are not households, but farms, out of all proportion to their share of the economy and workforce. In Israel, agriculture accounts for 3 percent of the gross domestic product and 57 percent of water consumption. The Jordanian agricultural sector contributes 6 percent of the GDP, but uses 72 percent of the water. In the less developed West Bank and Gaza Strip, agriculture absorbs about the same share of water, 64 percent, yet accounts for fully a third of the local economy. However, during times of drought it is Israel who controls the water sources and it is during these times that Palestinians, Syrians and Jordanians complain that their water has been cut off or cut short of the amount required by the treaties and agreements between these peoples

Jordan has also accused Syria of violating treaties in diverting water for agriculture, but the predominant complaints come to Israel from her neighbors. Clearly the solution to the need for water by these increasing populations lies in sober and fair assessment of the situation from a scientific view so that this diminishing resource can be fairly distributed. After the science has been determined to be sound, the recommendations need to be incorporated in treaties and laws to be obeyed by the parties involved. Otherwise, the most likely future will bring war again in the Middle East.

THE SCIENCE:

The problems are not with the science that preceded this treaty. Scientists representing Israel, Jordan, Gaza, West Bank, Canada and the United States have come together and analyzed the situation and determined the fair distribution of waters for all concerned. The latest effort of the scientific world to intervene with unbiased information and recommendations to these major Middle Eastern states involved in water issues is found in the following which has been taken from a summary of the document “Water for the

Future” published in 1999 the entirety of which can be found at (<http://www.nap.edu/books/030906421X/html/index.html>):

Representatives of the principal science councils of Israel, Jordan, the Palestinian Authority, and the United States first met in Washington, D.C., in 1994, to consider ways in which they might collaborate for the mutual benefit of their communities. After canvassing a range of problems of vital and common interest, they concluded that the most critical of these problems was ensuring sustainable water supplies in the Middle East. They decided to develop a joint study using the approach of the National Research Council (e.g., use of volunteer, multidisciplinary experts to write consensus reports on science and technology issues). They then appointed a committee with members from Israel, Jordan, the West Bank and Gaza Strip, the United States and Canada. This report is the result.

The Committee on Sustainable Water Supplies for the Middle East was formed by the U.S. National Research Council of the U.S. National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine; the Royal Scientific Society, Jordan; the Palestine Health Council; and the Israel Academy of Sciences and Humanities and has been supported by funds from the U.S. National Research Council. The plans for this study were developed during a meeting of the scientific Academies and Councils of the Middle East Region in Amman, Jordan in 1995.

The Study Area and Water Use:

The committee's deliberations were limited to the area of the West Bank and Gaza Strip, Israel, and Jordan, referred to as "the study area" in this report. The study area has a hot, dry climate, and consists of a dry coast and strip of dry upland forest that grades into semi-desert and desert. Most of the study area receives less than 250 millimeters (mm) of rainfall per year, about the same as or less than that received by Phoenix, Arizona, in the United States. The study area's highest rainfall amounts--those of more than 1,000 mm--fall in a small area of highlands in the northwestern part of the study area. By comparison, most of the United States east of the Mississippi River receives more than 800 mm of rainfall per year; much of the eastern United States and much of the Pacific Northwest west of the Cascades receive 1,000 mm or more.

The study area has approximately 12 million inhabitants, with varying proportions in urban centers and holding a variety of occupations. In 1994, the study area's total average annual water use was estimated to be 3,183 million cubic meters (million m³), ranging from almost 2,000 million m³ in Israel to approximately 235 million m³ in the West Bank and Gaza Strip. The average annual per capita use in the area, while highly variable, was approximately 260 cubic meters in 1994, and has been increasing. For the study area as a whole, agricultural irrigation accounts for more than half the water use, from an estimated 57 percent in Israel to 72 percent in Jordan, without considering wastewater that may be reused for irrigation. The several problems of water and the environment are

similar to those in some neighboring areas and in some distant regions, such as arid sections of the United States and Australia.

The study area's inhabitants will almost assuredly live under conditions of significant water stress in the near future. Barring completely unforeseen events, the population is likely to grow, and very rapid growth is possible. The study area will probably continue to develop economically, and such growth could be substantial in Jordan and the West Bank and Gaza Strip. Because of the disparity between the economic progress of Israel compared to Jordan and the West Bank and Gaza Strip, some of the technical water-conservation and supply-augmentation options may be phased in over a long period of time.

Water and the Environment:

The importance of ecosystem services to the sustainability of water supplies is often overlooked in the context of the region's water supplies. Ecosystem services refers to any functional attribute of natural systems that is beneficial to human society, nature, and wildlife. A biologically impoverished natural system produces services of poorer quality and reduced quantity.

The ecosystems of the study area, as elsewhere, provide services that are instrumental in achieving the sustainability of human water supplies. Vegetation helps to control runoff, and many plants, especially in wetlands, help to filter water and reduce the adverse effects of floods. Plants help to reduce erosion by reducing the rate of surface flows after heavy rains, thus reducing sediment input to water supplies as well. Surface water also provides important services. Streams help to assimilate wastewater, lakes provide storage for clean water, and surface waters provide habitat for many plants and animals important to humans and to ecosystem functioning.

At the same time, all the region's ecosystems, terrestrial as well as aquatic, require water for their own sustainability to continue to provide the many ecosystem goods and services that people rely on. The sustainability of water supplies requires that natural ecosystems be regarded as a critical legitimate user of the study area's water resources. Natural ecosystems are essential for maintaining adequate supplies of high-quality water.

Biodiversity is also important. Many peoples, including those in the Middle East, are committed to protecting biodiversity, as reflected in laws and international agreements. In future land-use planning, the benefits of water-related development should therefore be evaluated against the lost biodiversity and the cost of reduced ecosystem services. Applying this approach to the Jordan River Basin as a whole would mean examining the effects of proposed measures on the biodiversity of wetlands, lakes, the lower river, and the Dead Sea coasts. Such an examination, lacking to date, should be an integral part of evaluating any proposed option that would affect water quantity or quality.

In short, without the services provided by natural ecosystems, it will be extremely difficult and expensive--perhaps impossible--to sustain high-quality water supplies for the people in the study area. Thus, environmental considerations are not an adjunct to planning for sustainable water supplies, but a major and essential component of such planning.

Hydrologic Relationships and Water Resource Planning:

Regardless of national boundaries, the waters of the study area are shared inasmuch as the region is hydrologically connected. Changes in the quantities and qualities of water available in one area will have impact on the quantities and qualities available in others. A good way to ensure that these consequential relationships are directly considered in water resources planning is to take a regional hydrologic viewpoint. For example, the failure to view water resources planning regionally could lead to indiscriminate groundwater development of the Mountain Aquifer that underlies both Israel and the West Bank. Systematic determination of well locations would maximize the yield of this aquifer. A comprehensive hydrologic database to inform and support regional water resources planning is clearly needed.

Selected Options for the Future:

Achieving intergenerational fairness implies the need for a variety of management measures, some of which are discussed in this report. These measures include monitoring the quality of water resources; scientific and technological research and development to make more efficient use of available resources without contaminating or degrading the resource; intergenerational assessments of the effects of particular water projects and uses; effective maintenance of capital investments, such as dams, municipal sewage treatment plants and water delivery systems; protection of watersheds and aquifer recharge areas by appropriate land use planning; and systems for sharing the resources equitably among communities.

The committee identified several basic questions to consider when choosing among various water resource planning options:

1. How effective will the option be in enhancing available water supplies? Options that produce large increments in available water supply will be more desirable than those that have modest effects.
2. Are the options technically feasible? In evaluating options, care should be taken to assess technical feasibility.
3. What is the environmental impact of the option? Will the option reduce or increase the quantities or qualities of water supply for other uses? Does the option have any other adverse environmental impacts? How will it affect aquatic and terrestrial habitats? Will the option lead to losses of biodiversity or of species that may be particularly valuable?

4. Is the option economically feasible? What factors affect its economic feasibility? Has the option proven economically feasible elsewhere? It is important in answering these questions that all costs and benefits be reported together, with appropriate information about who bears the costs and who receives the benefits.
5. What are the implications for present and future generations? The quality of the environment must be maintained for future generations in a condition no worse than that of the current generation. Will the current generation's access to resources be conserved for future generations?

Conservation:

Given the rate of population growth, water quality and quantity will not be sustainable unless suitable conservation methods are used in all three major sectors of water use-- urban, agricultural, and industrial. Some middle ground must be reached in which quality of life and economic development are brought into balance within the practical constraints imposed by the available water. Measures to reduce the demand for water are generally well established, but often require societal or economic incentives to implement. By reducing the demand for water, conservation measures can have a positive effect on water quality and the environment.

Examples of voluntary, domestic water conservation measures include adopting water-saving plumbing fixtures (toilets, showerheads, and washing machines); limiting outdoor uses of water, as by watering lawns and gardens only during the evening and early morning; adopting water-saving practices in commerce; repairing household leaks; and discouraging use of garbage disposal units. Involuntary domestic water conservation measures can also be used, such as repairing leaking distribution and sewer systems; expanding central sewage systems; metering all water connections; and rationing, restricting, and recycling water use.

To the extent that the population grows or relocates in clusters, new water systems can be designed to reduce use and treatment costs, as by incorporating dual water systems to use non potable water for toilet flushing, garden irrigation, and similar applications. Dual systems reduce treatment costs and allow for recycling.

Agriculture:

The agricultural sector is the largest user of water in the study area. Conservation measures have already helped to reduce the area's agricultural water use. The reduction of Israeli water use by more than 200 million m³/yr between 1985 and 1993 was accomplished almost entirely in the agricultural sector through improved irrigation methods and water-delivery restrictions. Through rationing, research, and possibly through economic policies, agricultural water use may become even more efficient. However, as regional nonagricultural water demand increases and the cost of obtaining additional water supplies grows more expensive, the role of agriculture in the economy of

the study area may need to be reevaluated, (e.g., shifting from more to less water-intensive crops), so that water is used as efficiently as possible.

Harvesting local runoff and floodwaters can increase water supplies for dryland agriculture while evaporative water loss can be reduced by cropping intensively within closed environments. Computer-controlled drip "fertigation" (application of fertilizer in the irrigation water) economizes on water and fertilizer use and prevents soil salinization and groundwater pollution if drainage water recycling is used. Brackish water, often abundant in the study area's dryland aquifers, can also be used for irrigating salinity-resistant crops, increasing the sugar contents of fruits such as tomatoes and melons and hence their market price. Brackish water is also useful for intensive aquaculture in deserts, but it may also cause problems by increasing soil salinization.

Finally, the use of treated local or transported wastewater for subsurface drip irrigation of orchards and forage can dramatically increase the production of the area's drylands in a sustainable manner. In any reevaluation of the role of agriculture in the study area, the socioeconomic impacts as well as the environmental impacts of changing agricultural practices should be considered.

Augmenting Supplies:

Despite the best efforts to reduce water demand through conservation and economic policies, the available freshwater sources in the study area will probably have to be augmented by other sources to meet future needs. This is not at all to say that efforts at reducing demand are futile. Any alternate sources used will be expensive and, in some cases, will furnish lower quality water. Demand management in concert with supply augmentation will be needed to meet the future human and environmental water requirements of the area.

The rainfall of the region is not uniformly distributed over the year--hence there is a premium for storage of runoff when it occurs. In the north, where rainfall is relatively heavy, Lake Kinneret/Lake Tiberias/Sea of Galilee serves this purpose. In the more arid south, where surface reservoir sites are subject to large water losses from evaporation, subsurface storage has been used extensively. In ancient times, local cisterns were widely used, and this is still a valuable method for developing storage. Artificial recharge of ground water is another method that is currently in use in several places. As urban centers and their paved areas and infrastructure grow, there will be more opportunity to capture runoff from rainfall and use it to recharge ground water.

Additional regional water supplies can be obtained by the following means:

1. Using what little naturally occurring freshwater is currently unused (through watershed management and water harvesting); reusing water (wastewater reclamation).

2. Developing sources of lower quality water (use of marginal quality water and desalination of brackish water and seawater).
3. Importing water from outside the study area, by transferring unused water within the study area (water imports and transfers are mentioned but not analyzed in this report).
4. Attempting to increase the renewable amount of water available (cloud seeding).

SOLUTIONS THROUGH EDUCATION:

Clearly the solutions to the increasing need for water in the Middle East lie in cooperation and adherence to the scientific recommendations of unbiased committees such as those included above. But cooperation does not come without understanding, so in the following lessons, students are led to see the situation from various perspectives with the hope that they will see a clearer path to peace in the Middle East than their parents have.

The following lessons are designed to lead students through an analysis of the Middle East water situation. I expect the students to learn first the geography of the Middle East in general, with emphasis on location of major water sources and the geology of the region (Lesson 1). I also want the students to become familiar with the geography and ecology of the specific area involving Israel, Egypt, Iraq, Syria, Jordan and Lebanon (Lesson 2). During this part of the unit, students will be involved in identifying which country has control of the water supply and identifying with the culture and ecology of their state as they create a diorama and presentation of the culture and ecology of their region. Then we view a history of the water problems between Israel and Jordan and study the treaty signed to solve the problem and search current news reports to determine how well the treaty is working (Lessons 3 and 4). Next we'll investigate what scientists are doing today to help realize the treaty relating to the West Bank and Gaza Strip and compare their cooperation strategies (Lessons 5 and 6). Students will then put all the information they have together and solve a problem of water in the Middle East (Lesson 7) and a follow up in which water is involved in trading for peace in Gaza (Lesson 8). Finally the unit will culminate in a study of the specific argument over the Golan Heights where students will use their previously gained knowledge to defend a position of their choice on this controversy (Lesson 9). During this political survey, I want to emphasize what options these nations have tried in order to solve their water needs, with an emphasis on solutions rather than problems.

Lesson One - Getting our Bearings

First students need to become acquainted with the geography and geology of the Middle East region in general. To make learning these foreign countries fun, go to: http://www.yourchildlearns.com/puzzle_mea.htm and download the interactive software for the Middle East Map Puzzle. If you don't have access to a computer, make a map puzzle from any good map of the area. I suggest the following political map from U.

Texas:

http://www.lib.utexas.edu/Libs/PCL/Map_collection/middle_east_and_asia/MidEast_pol_97.pdf. Have the students make their own maps from the map sheets on cardboard or poster board. Then have races to put the maps together the fastest. A good outline map may be found at: <http://www.graphicmaps.com/webimage/countrys/asia/meoutl.htm> and below are the states you want the students to know.

There are many good maps on the Internet and also available through your local library. The goal of manipulating these maps is to get a perspective of the relative sizes and locations of the countries and to get an idea of which countries share borders. <http://www.mtech.on.ca/rec/953676656.html> - Middle East Geography - A printable worksheet about Middle Eastern countries, and geographic features
http://www.education-world.com/soc_sci/geography/images/middle_east.gif - Middle East Map - A printable political map depicting the countries of the Middle East



Lesson Two - My Land My Culture

In this lesson students are asked to become familiar with the peoples who make up the primary players in the Middle East crisis. For this set of exercises you will need a topographic map of the Middle East. National Geographic has many excellent maps online at <http://www.nationalgeographic.com/mapmachine>. You may choose one from satellite imagery that shows the vegetation as well as the terrain. Students will use a blank map to color in the vegetation and indicate where mountain uplift and desert regions are located. Then select maps that zoom in on the specific area surrounding Israel, Egypt, Iraq, Syria, Jordan and Lebanon and look for river basins, and ground water resources in this area.

Divide students into groups that represent these six nations. Have each group locate the major rivers of the area and answer questions such as the following in a presentation about the Middle East from your country's perspective:

1. Describe the climate, geography and population of your country.
2. Determine the rainfall patterns in your state.
3. What are the major rivers in your land?
4. Which nations might you argue with over the water supply from these rivers?
5. Which nation has present control of the water supplies in your state?
6. How much of the water in your land is renewable?
7. How much water do the inhabitants of your land withdraw for their use?
8. What percentage of your land is under cultivation?
9. Where are the ground water supplies in your state?
10. Where do the inhabitants get water other than from rivers and ground water sources?
11. What are the natural living and non-living resources of your state?
12. What cultural patterns or ways of life have sustained your people in their land?
13. Find music, costumes, art and pictures of your country and produce a diorama and presentation of the arts and customs of your country.

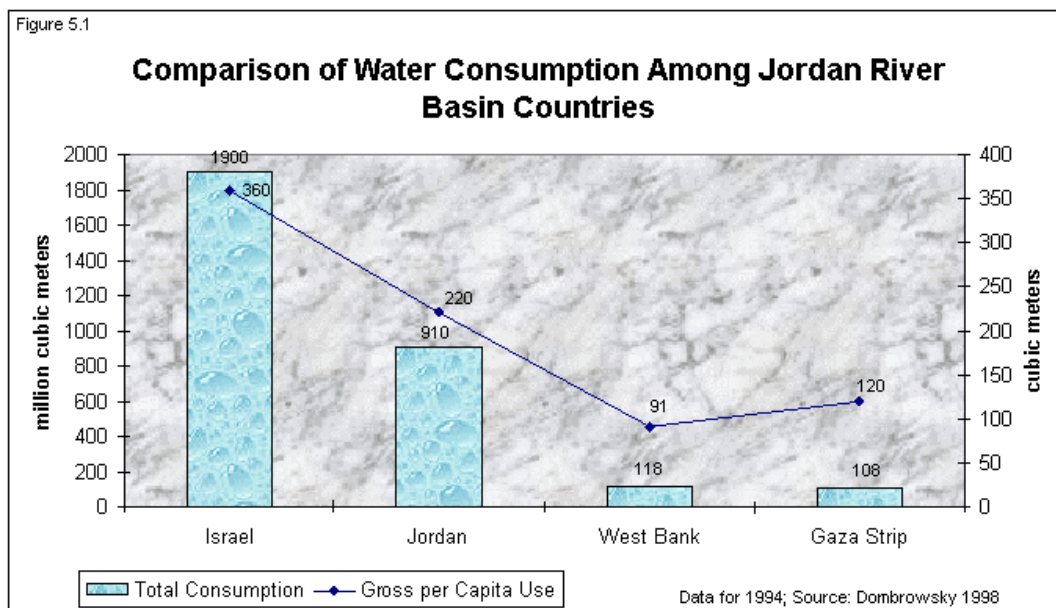
A good resource for some of the more technical questions is:

<http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/neareast.htm>

Tables can be found at:

<http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/neareast.htm>

Lesson Three - Overview of the Problem



View the following films:

Rivers of Fire -- (40 Minutes)

This video highlights the little known Middle East conflict over a natural resource more valuable than oil--WATER. Control of water is probably the ultimate weapon in the Middle East and it is an issue which will continue to threaten the stability in a region where each country has a spiraling population, creating an ever-increasing demand for water coupled with a steadily diminishing supply.

Water Wars -- (30 Minutes)

Could the war of the next century be over water rather than oil or politics? This video focuses on the apparent water inequalities between Palestinians and Israeli settlers in the West Bank and Gaza.

Suspended Dreams -- (Developing Stories)

This documentary film examines how the destruction of Beirut during the Lebanese civil war affected the lives of four people: a stage actor whose theater has been destroyed, a mother of two whose husband is missing, and two former soldiers who had once fought each other but who have since then become friends. Film recounts their struggles to reconstruct their homes and lives amid the chaos, the broken buildings, the unexploded mines and assesses the appalling impact of modern warfare on the environment while looking ahead to a new conflict in the making over water. 1992. 49 min. Video/C 3869

These three films and more can be found at the University of Utah's Middle East Outreach Program at <http://www.hum.utah.edu/mec/resourceroom.html> or obtained by emailing the librarian in the resource room, June Marvel at JN.MARVEL@m.cc.utah.edu. She will happily mail them to you to use in your classroom. After viewing these films, have students discuss the issues contained in the material presented with emphasis on what their feelings would be if they were living in these lands. Perhaps students should take on the role of one of the characters and write a diary or letter telling how they feel.

Lesson Four - A Brief History of the Conflict

Pass out *The Problem* section from this unit and have students take notes on the important dates and events therein. Having provided students with this brief outline of the events that have led to the current state of affairs, create a project to relate the acquisition of land and water by Israel to a time line of the events described in the brief history. Using a map that shows the rivers and watershed areas of the area, students will draw a timeline of events above the map to connect the significant events to areas on the map that were involved. Use color-coded shading and lines drawn from the area on the map to the point on the timeline. Label on the map where the National Water Carrier is located and where dams and other manmade structures are to be found.

Lesson Five - Treaties Made and Broken

Allow groups of students to read the summary of the Treaty of Peace signed October 26, 1994 included in *A Treaty* and discuss and outline the major points.

Having handed out the summary of the 1994 Peace Accord, students will calculate how much water each of the parties are entitled to and from what source this water comes. Then students will research the news using a key word search such as "Jordan Israel water dispute treaty" to find out if there have been any instances when either parties has broken this accord and will report to the class on their findings.

Here are a few resource examples:

<http://www2.haaretz.co.il/special/water-e/a/353879.asp>. An article from *Har'ratz* magazine March 2000.

<http://www.noor.gov.jo/main/watermsg.htm>. A letter from the Queen Noor of Jordan to the Water Dispute and Development Conference.

<http://www.jordanembassyus.org/040799002.htm>. A report from the *Jordan Times*, April 7, 1999 entitled "Tensions Eased In Jordan Israel Water Dispute."

Lesson Six - Scientists Search for Solutions

Students should be given the portion of the narrative called *The Science* to divide up and read and report on to each other in small groups. The full version is available at <http://books.nap.edu/catalog/6031.html> and students can elaborate from that version as well as get maps and other illustrations by searching for key terms within their portion of the document. Students should compile a class list for general discussion of what should be done to insure plentiful and safe water in the region.

Also investigate what has been done to increase the water supply or to use "virtual water" at

http://www.up.ac.za/academic/libarts/polsci/awiru/vw_study_ch4.html a good resource to explain what that is. Look more closely at desalination as a possible solution. At

<http://www.jordanembassyus.org/120299008.htm> an expert looks at desalination in the *Jordan Times*, December 1999. And check out imported water from other countries such as Turkey; at <http://www.arabicnews.com/ansub/Daily/Day/991220/1999122026.html> is an article about Israel importing water from Turkey and Egypt.

<http://www.igc.org/desip/WillNile2.html> is an article called "Nile Water to Israel?" from *Middle East Policy*, September 1997.

Evaluate these solutions together as a class and compare the technological fixes and economic possibilities to the regional population growth estimates for the future to determine what approaches are best to solve the future water problems in the Middle East.

http://research.mckenna.edu/roberts/Thesis%20On-Line/chapter_5.htm is a good resource to find information on population growth and water use in the area.

Lesson Seven - Water for Peace

Lessons Seven through Nine are taken from the resource <http://www.nytimes.com/learning/teachers/lessons/archive.html> which is a valuable resource for teachers from the *New York Times*. I've used these lessons because the work we did at the Houston Teachers Institute with Dr. Nogee involved reading the *New York Times* and determining lessons that could be taught from articles in the paper.

Procedure:

1. Ask students: "What is the most valuable resource in Southwest Asia?" Many students may answer oil, based on their understanding of the industrialized world's dependence on petroleum. Challenge their assumptions by suggesting that the most valuable resource in that region in coming years may be water.

Tell students that in this activity they will become representatives from Israel, Jordan, and Syria. Their job is to figure out peaceful ways to resolve differences over claims to water. To do so, they must investigate in depth the land and climate of their region, research the region's sources of water and the changing demands for water, and examine conflicting claims.

2. Begin by reviewing with students what they know of the politics, culture, and economy of this region. Note their responses on the chalkboard.

You may find it necessary to supplement with the following facts:

- * Israel and Jordan have suffered droughts in recent years.
- * Hundreds of thousands of Jews have immigrated to Israel from the former Soviet Union since the late 1980s.
- * About 300,000 Palestinians fled to Jordan from the Gulf states in 1990 and 1991 as a result of the Persian Gulf War.
- * Syria has built dams that divert water from Jordan and Israel.
- * Aquifers in south Jordan contain fossil (nonrenewable) water.

3. Organize the class into groups of three and distribute the investigation worksheets. Have students decide which members of the group will represent Israel, Jordan, and Syria.

Explain that they will use Encarta Virtual Globe to research the following:

- * The geography of the region, to understand the source of its water, why its supply is limited, and why international cooperation is necessary.
- * The ways in which water is used, and why demand for water is increasing.
- * Outline the reasons why their assigned country needs water and the basis for its disputes with its neighbors over water.
- * Share information on their assigned country with group members and formulate a plan to resolve water problems in the region.

4. As students conduct their research, move about the room to ask or answer questions. If computer access is limited, provide students not working at the computer with books and periodicals on Southwest Asia.

5. Informal Assessment: When groups have completed their assignments, ask each group to present its ideas on how to resolve water conflicts along the Jordan River. Then the class will evaluate all the proposals and decide on the one they believe is best.

Determine how well students have completed the objectives for this task.

- * Did students investigate sources of water in Southwest Asia? Do they understand the geographic reasons for water disputes?
- * Did students research the economic and social reasons for water use in their assigned country? Do they understand the increased demand for water?
- * Do students understand the various claims to water by Israel, Jordan, and Syria?
- * Did students recommend and evaluate peaceful ways to resolve water conflicts in Southwest Asia? Did students choose the plan they believe is best?

Lesson Eight - Give and Take

Negotiating a Peaceful Trade Agreement

Students will read and discuss the article "In Gaza, a Prototype of Peace via Trade." Students will then participate in mock negotiations of a trade agreement. From http://www.nytimes.com/learning/teachers/lessons/981014wednesday.html?searchpv=learning_lessons

1. Students spend the first five minutes of class writing in response to the following prompt: "Describe a situation in which you had to reach compromise with a person with whom you fundamentally disagreed."
2. Students read the *New York Times* article "In Gaza, a Prototype of Peace via Trade." Locate Israel and the Gaza Strip on a map; then ask students to respond to the following questions based on the content of the article:

--What is an industrial park?

- Why is the opening of an industrial park in Gaza viewed as an economic breakthrough?
- What obstacles face businesses in the Gaza Industrial Estate?
- What compromises and accommodations will the Israelis and the Palestinians need to make for the industrial park to be an economic success?
- How might the opening of the industrial park affect the economy of Palestine?
- How might economic partnerships between Israeli and Palestinian businesses affect government policies and the future of the region?

3. Explain to students that they are going to take part in an exercise in trade negotiations. Describe the following scenario: The Eastsiders and the Westsiders represent different communities that share a border. They have a deep mistrust of each other and have a history of attempting to expand their borders, leading to frequent wars and other conflicts. Now these old enemies are trying to negotiate an agreement based on economic needs.
4. Write the following on the board or distribute on paper to all students:

Eastsiders:

Eastsiders live on the east side of a road. The east side of the road is a lush, forested region. A river flows along the side of the road and empties in to a freshwater lake. The main source of income for Eastsiders is the manufacture of "lulu's." The "lulu" factory needs oil to operate, but there is no oil on the east side of the road. The closest, largest supply of oil is on the west side of the road, which is occupied by the Westsiders. Five years ago, the Eastsiders invaded the west side of the road in attempt to gain control of the oil supply.

Westsiders:

Westsiders live on the west side of the road. The west side of the road is arid, yet rich in oil. The Westsiders earn their money from the sale of oil. The west side of the road is a wonderful place to live, yet there is always a shortage of water for drinking and irrigation. The closest and largest water supply is on the east side of the road, which is occupied by the Eastsiders. Five years ago, the Westsiders invaded the east side of the road in an attempt to annex the territory that includes the lake into which the river empties, providing them with a supply of fresh water.

5. Assign half of the students in the class to be Eastsiders and half to be Westsiders. Then divide students into groups of 6, comprised of 3 Eastsiders and 3 Westsiders. Give the groups 20 minutes to try to negotiate a trade agreement between the old enemies that takes into account their shared border, their mutual needs, their history of war, and their deep mistrust of each other.
6. Students write a summary of the negotiation process and describe the agreements (if any) they reached. Students should describe the obstacles that complicated the

negotiations as well as the incentives they had to reach an agreement. Finally, they should reflect on how their negotiations might be similar to or different from negotiations between the Israelis and Palestinians regarding the Gaza Industrial Estate.

Lesson Nine - What about the Golan?

This lesson was taken from another *New York Times* teacher guide at http://www.nytimes.com/learning/teachers/lessons/000119wednesday.html?searchpv=learning_lessons

1. Students respond to the following in their journals (written on the board prior to class): "The Youngs live on Maple Street. The Scotts live on Elm Street. The families are neighbors because their backyards share an invisible property line. The Young children build a clubhouse in their backyard near the border of the two properties. The Scotts argue that the clubhouse is an eyesore and that it is too close to their property, so they tear it down. The two families take this matter to court, and the judge rules in favor of the Youngs. Instead of awarding the Youngs money, the judge rezones the property, giving the Youngs a large portion of the Scotts' backyard, which includes the water outlet for the Scott's garden. This sparks a tremendous feud between the families, and despite years of the families fighting in court about this issue, the Youngs maintain control of the yard and the water faucet. Write one paragraph from the point of view of the Youngs, and one paragraph from the point of view of the Scotts." Students then defend their responses.

2. Provide students with a brief history of the Golan Heights. Where is this region located? What is the geography of the area? Where is the water located? Who has control over the water? Who lives in the Golan Heights? What has been the interchange of the area between Israel and Syria in the twentieth century? Revisit the scenario of the dispute between the Youngs and the Scotts. How does this scenario relate to the conflict over the Golan Heights between Israel and Syria? What could the judge represent in this scenario in relation to the conflict over the Golan Heights? Explain to students that peace talks between Israel and Syria have been underway recently but have suddenly come to a halt. What, historically, have these countries fought over? Why do students think that the United States has become involved in the recent talks between these countries?

3. As a class, read and discuss "Further Israel-Syria Talks Are Postponed," focusing on the following questions:

- a. What has caused the postponement of the peace talks between Israel and Syria?
- b. Why is the United States involved in these talks?
- c. Why is it so important that, at this point in time, there is an attempt to bring Israeli and Syrian leaders together to try to form a peace accord?
- d. What does Syria want with regard to the Golan Heights?

e. What is the significance of the leak of the draft of the accord to an Israeli newspaper?

4. Divide students into three equal groups, and assign each group one of the following topics: political, economic, environmental, and cultural. Then, divide each of these groups in half, one half to be representing Israel and the other half to be representing Syria. In other words, students will eventually be divided into these eight groups: Israel--political, Syria--political, Israel--economic, Syria--economic, Israel--cultural, Syria--cultural, Israel--environmental and Syria--environmental. Each group of students then uses available classroom materials, including recent newspaper articles, to examine how their assigned country has been affected in the area of their assigned topic with regard to the conflict over the Golan Heights. (For example, the "Israel- political" group will investigate how the Golan Heights conflict has historically and is currently affecting Israel in a political sense.) Groups should aim to obtain as much information as possible.

4. Israeli Prime Minister Ehud Barak listed seven issues at stake in negotiations with Damascus: the Golan Heights, security arrangements, occupation of Lebanon, terrorism, water, diplomatic normalization, and opening of frontiers. Divide students into six small groups, and assign each group an issue (excluding the Golan Heights, which was covered in class). Each group researches the history of their assigned conflict, the views and desires of both Syria and Israel, what has happened in this peace process regarding this issue, and how their group would aim to resolve this part of the peace accord and why. Each group then presents their ideas to the class in a conference setting.

REFERENCES:

For articles, maps, or other media pertaining to this topic, look up the following in Encarta® Encyclopedia at <http://encarta.msn.com/>

Middle East

Israel

Jordan, Hashemite Kingdom of

Jordan (river)

Syria

Encarta Teacher's Network at <http://www.k12.msn.com/LessonConnection/Teacher.asp> is a good site for additional information and materials.

<http://www.nationalgeographic.com/gaza/index.html> - From National Geographic, and online article, maps, resources, and classroom activities for teaching about the Gaza strip and the border disputes that bring conflict to this area

The *New York Times* on the Web's special index "Issue in Depth: The Mideast Peace Process" <http://www.nytimes.com/library/world/mideast/mideast-peace-index.html> contains articles covering recent Israeli-Palestinian conflicts and relations, the 1999 Wye Accord, 1997's Hebron Agreement, and 1993's Oslo Accord. Also included are interactive maps and articles detailing the creation of the state of Israel.

The *New York Times* on the Web's "Issues in Depth: Politics in Israel" <http://www.nytimes.com/library/world/mideast/israel-politics-index.html> contains recent articles as well as articles from the Times archives, profiles of the candidates, and articles concerning religion and politics.

U.S. State Dept: Shepherdstown Peace Talks 2000

http://www.state.gov/www/regions/nea/shepherdstown_talks.html offers official remarks, some available in audio.

U.S. Department of State: Middle East Peace Process

http://www.state.gov/www/regions/nea/peace_process.html features an index of statements, information on the Wye River Summit, and links to related sites.

Israeli Ministry of Foreign Affairs <http://www.mfa.gov.il/mfa/home.asp> has updates on developments in the peace process, a section on Israel-Syria negotiations, policy statements, and other news.

Syrian Ministry of Information <http://www.moi-syria.com/> posts updates on politics and the economy; also has an overview of the country, its geography and history.

The Anatomy of the Arab-Israeli Conflict

<http://www.megastories.com/mideast/index.htm> includes an interactive map of Jerusalem, profiles of the parties to the conflict, and a history of the conflict.

Suggested Web sites of English-language Israeli and Syrian newspapers:

--*Jerusalem Post* <http://www.jpost.com> (Israeli)

--*Ha'aretz* http://www3.haaretz.co.il/eng/htmls/1_1.htm (Israeli)

--*Challenge*, a Jerusalem magazine on the Israeli-Palestinian Conflict
<http://www.odaction.org/challenge> (Israeli)

--*Syria Times* <http://www.teshreen.com/web/homes.htm> (Syrian)

The following Articles will be of interest:

A Vital Paradigm Shift to Maintain -- "Shaping the Future Together Along the Nile and Rivers in the Near East" Plans made by the Green Cross for a meeting in March of 1999 to reach agreement between Egypt and Jordan's respective water resources
<http://www.gci.ch/GreenCrossPrograms/waterres/texts/WaterForumProjME42.html>

Middle East Precipitable Water Closeup -- a map of the Middle East showing the precipitation in the area
http://www.cira.colostate.edu/mideast/v_ANN_ME.htm

"Middle East Water Issues" -- a listing of many references both online and published.
<http://www.biu.ac.il/SOC/besa/meria/research-g/water.html>

"Water Conflicts in the Middle East" -- another listing of references to water issues
<http://allserv.rug.ac.be/~sdconinc/waternet/ME.htm>

"Middle East & Water Web Sites" -- still more links and references!
<http://www.ssc.upenn.edu/~mewin/links.html>

IDRC Focus Collection: *Water Management in the Middle East* -- a book
<http://www.idrc.ca/books/focus/804/804.html>

Water Resources in the Middle East -- a bibliography from the Dag Hammarskjöld Library at the U.N.

International Water Management Institute -- Projected water scarcity in the year 2025
<http://www.cgiar.org/iwmi/home/wsmmap.htm>

"Water Wars in the Middle East" -- a student paper from Northwestern University's Political Science Class
<http://www.geocities.com/CapitolHill/3343/>