

# The Israeli Palestinian Mountain Aquifer: A Case Study in Ground Water Conflict Resolution

M. El-Fadel,\* R. Quba'a, N. El-Hougeiri, Z. Hashisho and D. Jamali

## ABSTRACT

The dispute between Israelis and Palestinians over shared water resources of the Mountain Aquifer is one potential obstacle in the path of peace in the Middle East. This aquifer is the only source of water for Palestinians in the West Bank and the main provider of freshwater to Israelis. The majority of its natural recharge area lies within the West Bank territories with two of its three basins flowing naturally toward Israel. In 1967, Israel occupied the West Bank and imposed strict control policies over the utilization of the Mountain Aquifer's water. At present, Palestinians and Israelis are moving toward a political resolution of their more than half a century old conflict. In the Declaration of Principles, Israelis and Palestinians created preconditions for the coming negotiations and the Israelis recognized water rights for Palestinians. There is no clear indication of the extent to which water would be under Palestinian control during the interim period, but there is an implicit recognition of the need to reform the existing water allocation system. In the Final Status Negotiations, the Joint Mountain Aquifer Committee, members from the Israeli government and the Palestinian National Authority must make decisions regarding the equitable distribution and joint management of the shared water of the Mountain Aquifer. This paper provides a decision case for a course at the graduate or senior undergraduate level based on water resources issues impacting the peace process.

IN THE MIDDLE EAST, the Arab-Israeli conflict involved intense disagreements over sharing scarce common water resources (Sosland, 1998). Due to the prevailing aridity, the Middle East is one of the poorest regions in the world in terms of water resources (Exh. 1). In most of the region, water consumption exceeds renewable potable water. Hence, most Middle Eastern countries are considered water stressed (Rosegrant, 1995). According to World Bank estimates, by 2025, renewable water supplies in the Middle East will barely cover basic human needs (Morris, 1998). The problem of water shortages is exacerbated by the fact that water resources in the region are shared by more than one country, a situation which fuels tensions over water rights and makes water a significant political issue (Haddad and Mizyed, 1996).

One of the most intricate water conflicts in the region is that of the Jordan River basin (Exh. 2). The involved parties are Jordan, Syria, the Palestinian Authority (defined as occupants of the Gaza Strip and the West Bank), Lebanon, and Israel. Major issues in the Jordan River Basin conflict include water flow, diversion, and ownership (Morris, 1998). In addition, the Palestinian-Israeli water conflict includes the Jor-

dan and Yarmouk River systems along with the Mountain Aquifer of the West Bank.

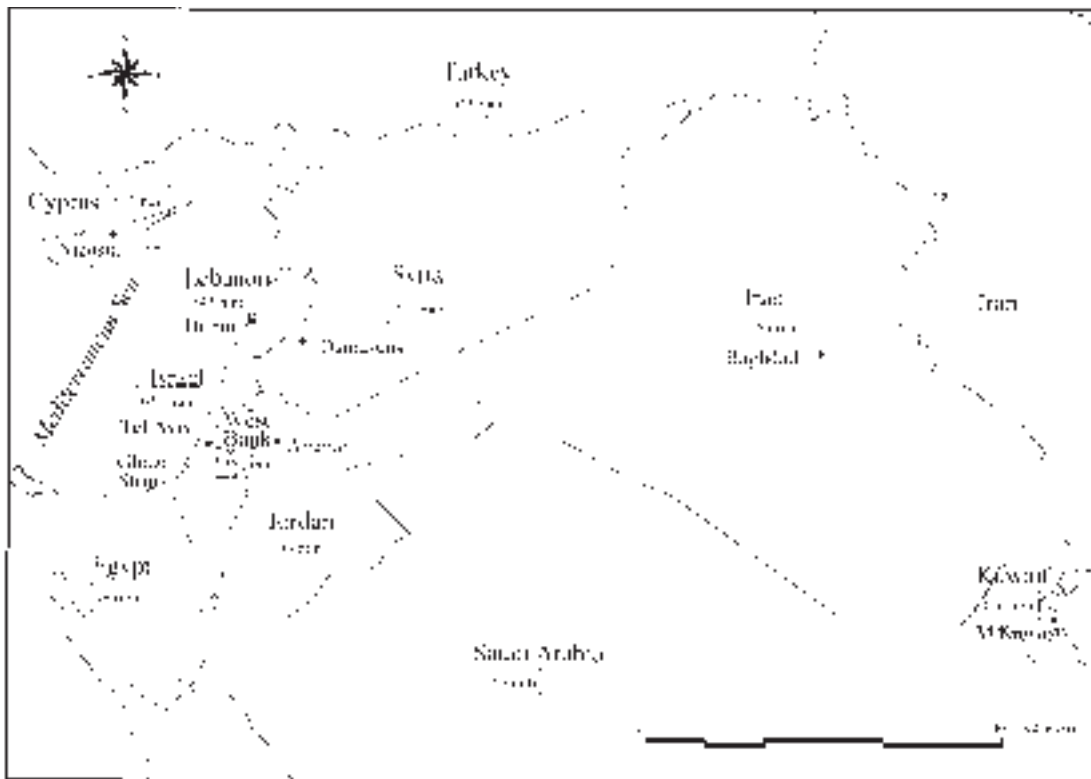
This case study focuses on the Israeli-Palestinian conflict over the shared water resources of the Mountain Aquifer. It is intended for use by graduate or senior undergraduate students to role-play as opponents, supporters, and/or mediators in a conflict resolution setting. The conflict over the Mountain Aquifer is exacerbated by the tense political and military conflict between the Israelis and the Palestinians, which dates back to the beginnings of the 20th century. Israelis tend to defend their water rights by stating that they have been using the major portions of the aquifer's water for more than 60 yr, and that reducing their present water allocation could cause them social and economic distress. On the other hand, Palestinians defend their water rights by stating that the majority of the Mountain Aquifer lies within the West Bank territory, they are the indigenous inhabitants of the region, and they are in greater need for water to build their industrial and agricultural sectors.

Although peace agreements were signed by both sides, such agreements did not fully normalize the relationships nor settle the conflicts. Allocation of shared water resources of the Mountain Aquifer is one of the political core issues that remain to be addressed in the permanent status negotiations (Libiszewski, 1995). Israeli and Palestinian members of the Joint Water Committee (JWC) are responsible for resolving this conflict. The JWC, established in accordance with the Oslo II agreement, is in charge of the protection and coordinated management of water sources and systems. The JWC must decide on an equitable ground water management scheme satisfactory to their respective constituencies. The decision should balance the allocation of available water resources with demand management (conservation and appropriate utilization of water supplies) and enhancement of existing supplies.

## THE CASE

The West Bank came under Israeli control following the Six Day War of June 1967 between Israel on one side and Jordan, Syria, and Egypt on the other. Since then, Israel has been closely monitoring water resources in these territories and hindering Palestinians from exploiting ground water resources, particularly the Mountain Aquifer. Israel has been utilizing about 80% of the West Bank's shared water resources leaving the Palestinians with about 20% (Libiszewski, 1995). Based on the Declaration of Principles (DOP), signed on 13 Sept. 1993, and subsequent agreements (Oslo I in May 1994, agreement on the preparatory transfer of power and responsibilities in August 1994, Oslo II in September 1995, and Wye River in October 1998), Palestinians and Israelis are moving toward a peaceful resolution of their overall political conflict. Although the DOP and Oslo II recognized the Pales-

M. El-Fadel, R. Quba'a, N. Al-Hougeiri, and Z. Hashisho, Dep. of Civil and Environmental Engineering, American Univ. of Beirut, Bliss Street, P.O. Box 11-0236, Beirut, Lebanon; and D. Jamali, Dep. of Political Studies and Public Administration, American Univ. of Beirut, Lebanon. Received 14 Sept. 2000. \*Corresponding author (mfadel@aub.edu.lb).



Exh. 1. Political map of the Middle East with annual rainfall (mm) in selected countries.

tinians' water rights, the larger issue of water resources management, and the concrete definition of water rights remain to be agreed on in the Final Status Negotiations (Isaac and Selby, 1996). The allocation of existing water supplies of the Mountain Aquifer has become an important issue that needs to be addressed in solving the Israeli–Palestinian dispute.<sup>1</sup> While 80 to 90% of the aquifer recharge area is in Palestinian territories, the majority of the aquifer's water is used by Israelis. Over-pumping threatens water quality of the whole aquifer since its basins are hydraulically connected. The geography and hydrology of the aquifer are factors considered in dividing water according to international law.

### Aquifer Characterization

The Mountain Aquifer is the main ground water basin in the region. It supplies nearly all of the West Bank's water requirements and one-third of Israel's water budget. It is located west of the Jordan River covering the central area of the West Bank and a wide strip of adjacent Israeli territory (Exh. 3). Based on water flow direction, it can be divided into three general basins: the Western basin (also referred to as Yarkon–Tanninim in Israel), the North Eastern basin, and the Eastern basin. The permeable recharge areas extend along the upper mountain slopes and ridges at an altitude of 500 m above sea level. The aquifer is exploited through its natural springs and a network of artesian wells. Its potential yield varies consid-

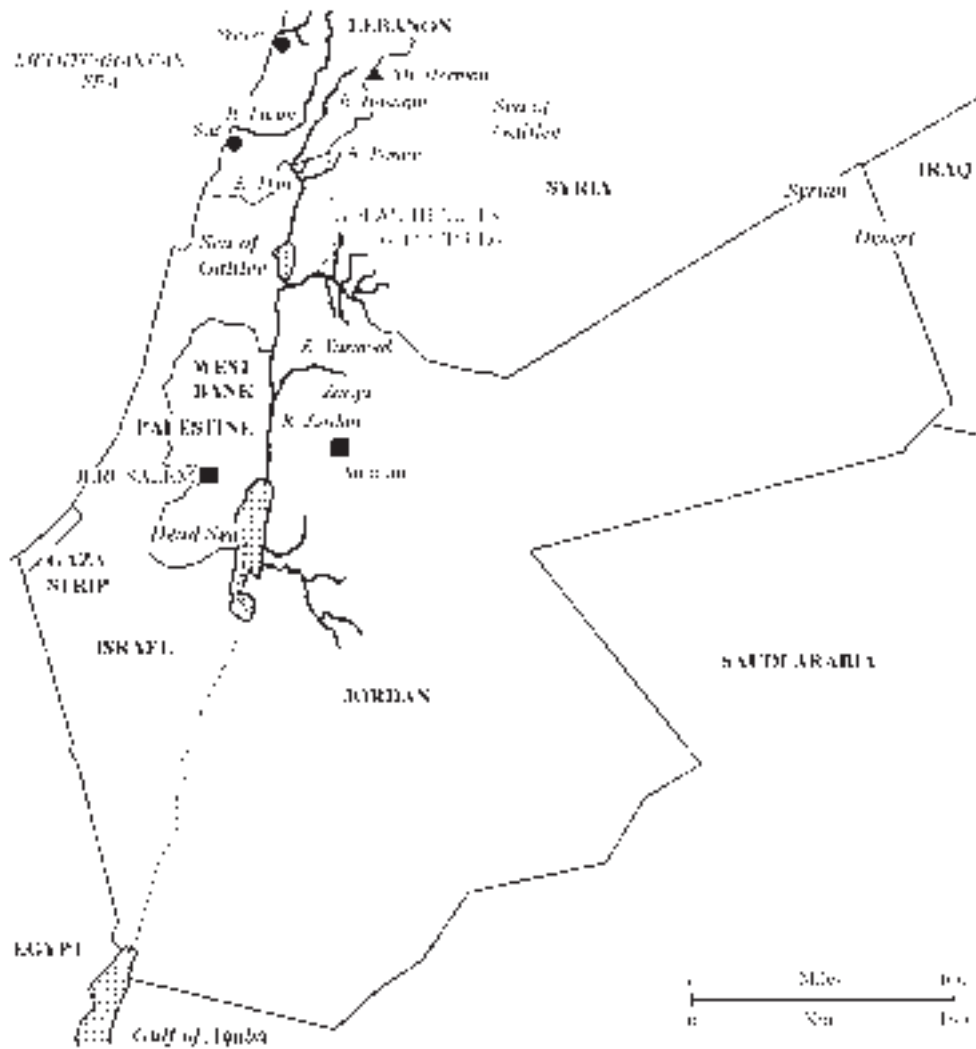
<sup>1</sup> While there are more pressing issues to be resolved (such as the status of East Jerusalem, the right to return of Palestinian refugees, the disposition of Israeli settlements, the final borders of the new Palestinian state and the sovereignty of this state) this does not underestimate the significance of the conflict over water.

erably depending on the reporting source (Exh. 4). Israeli researchers tend to underestimate shared water resources to protect them from new claims and overestimate exclusively Palestinian water resources. Conversely, suspicious about the political dimension of Israeli researchers, Palestinian researchers tended to overestimate shared water resources and underestimate exclusively Palestinian water resources (Alatout, 2000). Safe yields of 632 million m<sup>3</sup>, including natural recharge of springs and 180 million m<sup>3</sup> of brackish water (i.e., having more than 400 mg/L of total dissolved solids), were estimated and agreed on by a joint team of Israeli and Palestinian water experts (Libiszewski, 1995).

### The Western Basin

The Western basin is the largest and most abundant basin. It consists of several subaquifers that supply more than half of the Mountain Aquifer's total yield. Estimates of the annual renewable yield of this basin vary between 310 and 350 million m<sup>3</sup>. About 40 million m<sup>3</sup> are brackish rendering them unsuitable for most use. Politically, the Western basin can be considered as transboundary since it crosses the 1949 United Nations Armistice Demarcation Line (also called the *Green Line*). About 80 to 90% of the basin is recharged by precipitation falling within the boundaries of the West Bank area. The water then flows underground in a western direction toward the Mediterranean Sea (Libiszewski, 1995; Shuval, 1996).

Historically, the local Palestinian population utilized part of the springs' flow and about 20 to 27 million m<sup>3</sup> from traditionally drilled wells in the coastal area. With the onset of an organized worldwide Jewish migration into Palestine at the end of the 19th century, the new settlers started sharing water



Exh. 2. The Jordan River basin (adopted from Dolatyar and Gray, 2000b).

resources with Palestinians. In the 1920s and 1930s, the settlers initiated an intensive exploitation of the ground water. This exploitation was further promoted by Israel between 1948 and 1967, and by Israelis who settled on the West Bank after the Six Day War (Libiszewski, 1995). At present, >90% of the Western basin is used by Israel<sup>2</sup> (300–333 million m<sup>3</sup> are used by Israel from its side of the Green Line, and 10 million m<sup>3</sup> are used by settlements within the West Bank). The total consumption from this aquifer is in surplus of the basin's safe yield (Shuval, 1996).

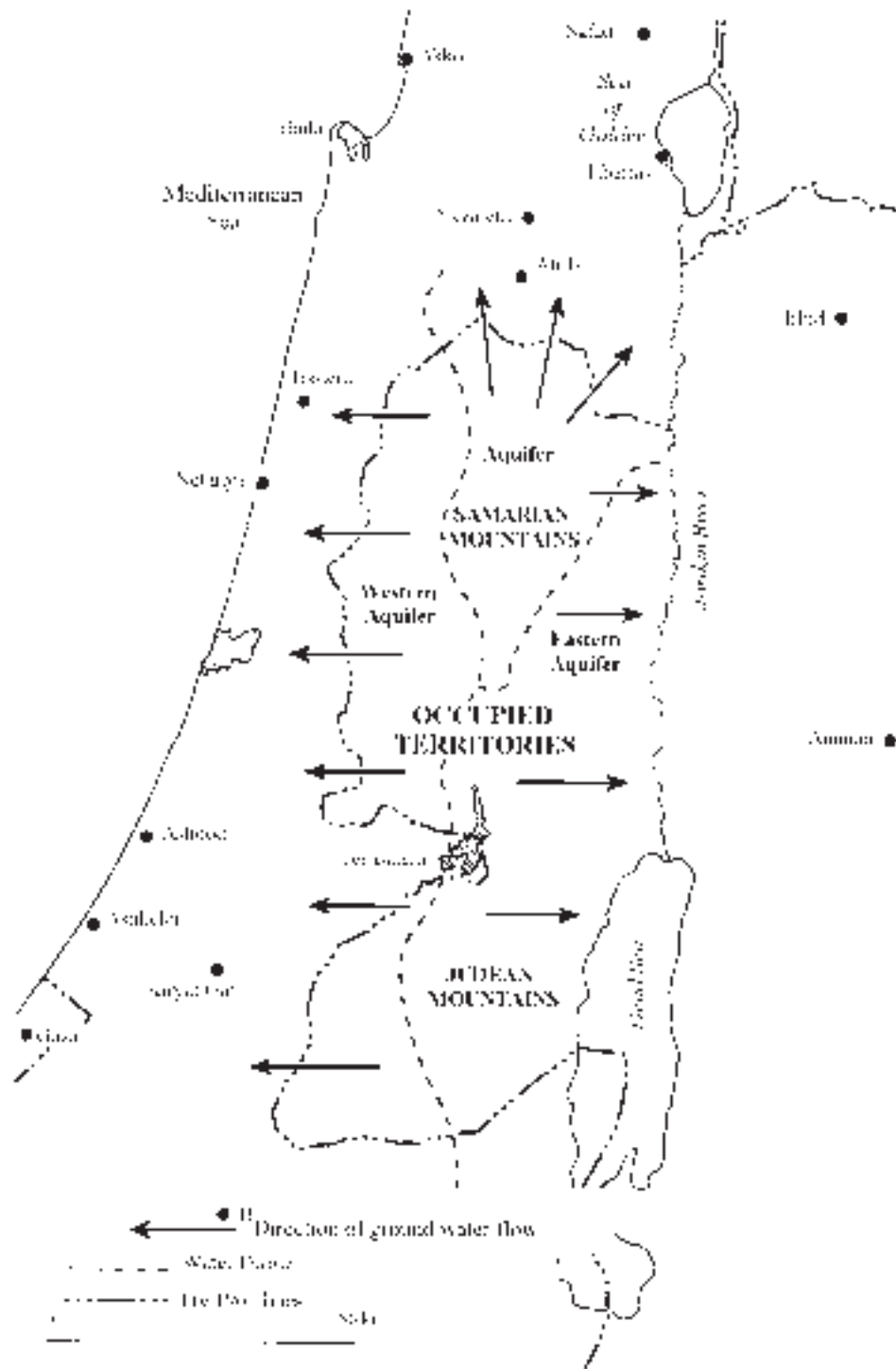
### The North-Eastern Basin

The V-shaped Northeastern basin is the second largest basin. It contributes about 131 to 140 million m<sup>3</sup>, of which 70 million m<sup>3</sup> are brackish water. Most of this basin's water originates from rainfall in the West Bank and flows north and northeast into Israeli territory (Alatout, 2000). Similar to the Western aquifer, it is considered as transboundary because it crosses the Green Line. About 75% of this basin's water is

used by Israel (101–115 million m<sup>3</sup>). Palestinians in the West Bank are allowed to use 20% (20–25 million m<sup>3</sup>/yr), and Jewish settlers in the same region use about 5 million m<sup>3</sup>/yr from this basin (~5%).

Water usage patterns in the Northeastern basin have been historically similar to those in the Western one. Local Palestinian villagers utilized some springs and wells, while a portion of the aquifer's flow was used by early Israeli settlers. After 1948, the Israelis gained full control over that aquifer (Libiszewski, 1995; Sosland, 1998; Shuval, 1996). Hence, from a political perspective, both the Western and the Northeastern aquifers can be considered as shared transboundary water resources (i.e., their replenishment and discharge areas are under the control of different political entities). This led to the notorious upstream–downstream dilemma. Also, ground water in both aquifers is mainly of good quality, and are largely used for domestic purposes, constituting the main drinking water supply for both Israelis and Palestinians (Libiszewski, 1995). Therefore, the sharing of these basins and the allocation of their waters between Israelis and Palestinians are important and sensitive issues to be resolved in the Final Status Negotiations. In particular, issues such as the location and monitoring of pumping wells, monitoring of water quality, as

<sup>2</sup> Additional information on consumption are presented in the next section on Water Allocation and Demand.



Exh. 3. The Mountain Aquifer (adopted from Shoval, 1996).

well as aquifer conservation and pollution prevention should be settled.

**The Eastern Basin**

Compared with the other basins, the Eastern basin cannot be considered an international water resource. It is composed of several subaquifers that lie entirely within the West Bank territory. Water from this basin flows eastward and discharges into the Jordan River and the Dead Sea (Exh. 3). Estimates of

its potential yield vary between 125 and 151 million m<sup>3</sup>/yr. While Palestinians in the West Bank use 39 to 48% of the water from this aquifer, Israeli settlers use up to 60% (Exh. 4).

**Aquifer Geology**

The basin consists of two main strata, the Upper and Lower Cenomanian, separated by an impermeable layer of several hundred meters in thickness. The Upper Cenomanian, which is a relatively thin stratum, drains naturally eastward into a se-

**Exhibit 4. Various estimates of the Mountain Aquifer annual recharge rate.**

Basin	Palestinian allocation				Israeli allocation				Total capacity			
	1†	2	3	4	1	2	3	4	1	2	3	4
	million m <sup>3</sup> /yr											
Western	25	27	20	22	310	323	300	340	335	350	320	362
N-Eastern	30	25	20	42	110	106	120	103	140	131	140	145
Eastern	60	58	50	54	35	35	75	40	125	151	125	172
Total	115	110	90	118	485	463	495	483	600	632	585	679

† 1 = Zarour and Isaac, 1991; 2 = Shuval, 1996; 3 = Wolf, 1993; 4 = Sosland, 1998.

ries of springs used by Palestinians. This stratum has limited storage capacity and its recharge is dependent on the rainfall of the previous season. The lower Cenomanian on the other hand, is a deep stratum with fresh water flowing naturally from high mountain infiltration areas in the east down to the Jordan Valley, where it mixes with a layer of saline ground water (Shuval, 1996). Before 1967, Palestinian villagers and farmers used this basin, the lower Cenomanian, exclusively. After 1967, the Israeli authorities extended their control to this section of the Mountain Aquifer and used it to supply Israeli settlements in the area by tapping the fresh water sources along the upper slopes. Similar to the other basins, this ground water is the only source of fresh water for both Palestinians and Israeli settlers living on the eastern part of the West Bank due to the high salinity of the lower section of the Jordan River waters.

### Environmental Stresses

The water quality of the three basins is threatened by over-pumping and the resulting rapid rate of saline water infiltration. The use of the Western and North-Eastern basins reached the limit of safe yield in the mid-1970s, while the Eastern basin still contains an unutilized portion of about 60 million m<sup>3</sup> of brackish water that requires treatment before usage. In several parts of the Eastern basin, wells have been over-pumped. For example, the water table in the Jordan Valley has dropped 16 m since 1969, which has resulted in the deterioration of the water quality. Over-exploitation can lead to the seepage of brackish water into the fresh water body since nearby saline layers underlie the fresh water layers. It is reported that total salt and chloride concentrations have risen by 130 and 50%, respectively, between the years 1982 and 1991 (Libsiewicz, 1995). Similar deterioration in water quality is also reported in some parts of the Western basin.

### Water Allocation and Demand

As part of political pressure, Israelis and Palestinians have been at odds since the beginning of the 20th century because of historical territorial disputes. Palestinians consider themselves the indigenous population and resent the worldwide emigration of Israeli settlers to their old Palestine territory. Israelis

**Exhibit 5. Total and per capita consumption in Israel and the West Bank for 1990 Isaac and Selby, 1996).**

	Israel	West Bank and the Gaza Strip	West Bank settlers	Palestinians in the West Bank
Annual total consumption, million m <sup>3</sup>	1700	219	65	123
Population, millions	4.6	2.07	0.1	1.33
Annual per capita consumption, m <sup>3</sup>	370	107	650	93

consider this land as their historical, undisputed biblical land. Religious, ethnic, and linguistic differences exacerbate the nature of the conflict. The majority of Palestinians are Moslems or Christians with Arabic ancestors, whereas Israelis are primarily Jewish and a majority are recent European emigrants who arrived in the country following World Wars I and II.

The tense political relations between Israelis and Palestinians were exacerbated by the Israeli nationalization of the West Bank's water resources in 1967. Limits were placed on the amount of water that could be withdrawn from each existing well to satisfy Palestinian water demands. On the other hand, new wells were drilled to account for the water needs of new Israeli settlements (Wolf and Ross, 1992). Stringent Israeli water policies prevented Palestinians from exploiting ground water in the West Bank for more than three decades. Permission for well drilling had to be obtained from Israel's military authorities. Between 19 and 46 ground water exploitation permits were granted, according to the reporting source (Sosland, 1998; United Nations, 1992), between 1967 and 1991. In addition, pumping was controlled through heavy fines determined by the Israeli civil administration (Isaac and Selby, 1996). Current water supplies in the West Bank are insufficient to meet actual needs. Although most Palestinians survive on water tank supplies for several months, some districts of the West Bank were without piped water until 1990. Currently, 26% of Palestinian households have no piped water. Comparable shortfalls in domestic water supply in Israel are uncommon. These restrictions by Israel are not consistent with international rules governing occupation such as The Hague Regulations of 1907 and the Fourth Geneva Convention (Farinelli, 1997).

The situation has been changing after the signature of the Oslo II agreement, which resulted in an increase in the amounts of water allocated to Palestinians during the interim period. As such, 70 to 80 million m<sup>3</sup> have been made available for Palestinians to use at a cost. Pumping is being controlled through a joint Israeli-Palestinian monitoring and enforcement committee. Although the rigorous quotas imposed on Palestinians are being relaxed, Palestinians still consume far less on a per-capita basis than Israelis. In this context, the average Israeli consumes 3.5 times more than the average Palestinian. The per-capita consumption of Israeli settlers is seven times that of Palestinians in the West Bank (Exh. 5). In addition, Palestinians continue to pay higher premiums than Israelis for their water supply. While settlers pay \$0.35 to \$0.4/m<sup>3</sup> for domestic water and \$0.16 to \$0.19/m<sup>3</sup> for agricultural water, Palestinians pay a standard rate of \$1.2/m<sup>3</sup> (Isaac and Selby, 1996; Lithwick, 2000).

Water for agricultural use is another important factor in the Israeli-Palestinian water crisis. Seventy to 80% of the re-



**Exhibit 6. A comparison between Israeli and Palestinian agriculture sectors.**

Parameter	Isaac and Selby, 1996		Various sources	
	Israel	West Bank and Gaza Strip	Israel	West Bank and Gaza Strip
Agriculture sector contribution to GDP, %	6	23–29	2†	33†
Agriculture sector contribution to total employment, %	3.5	26.3	2.6†	13†
Irrigated agriculture land, %	47	9	49.43§	10.36§
Total water consumption, million m <sup>3</sup>	1700	225	1710‡	220‡
Agricultural water use, as % of total consumption	75	62	64‡	73‡
Total annual water consumption for irrigation, million m <sup>3</sup>	1275	140	1094‡	160‡
Population, millions	4.56 (1990)	2.03 (1990)	5.75 (1999)†	2.72 (1999)†
Per capita annual water consumption for irrigation, m <sup>3</sup>	280	69	190	59

† CIA, 2000a (Israel); CIA, 2000b (West Bank).

‡ Arlosoroff, 1996.

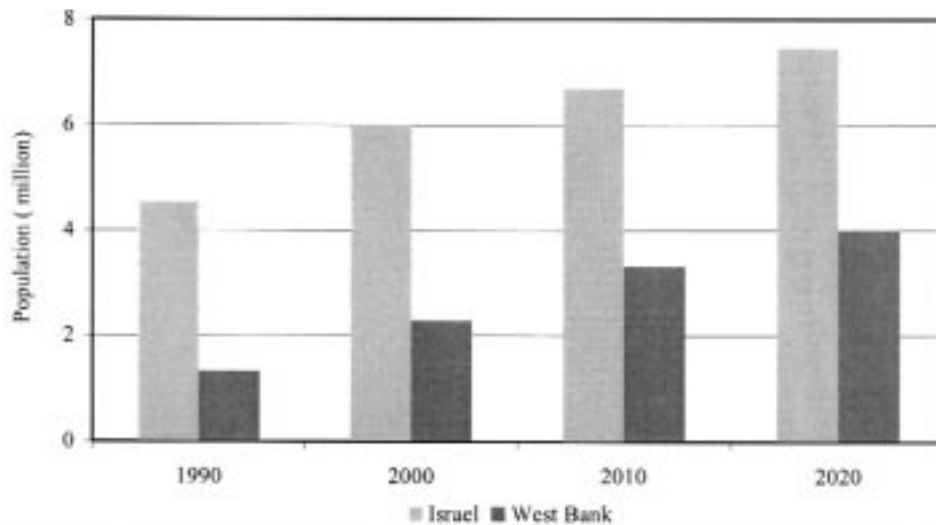
§ Awartani, 1994.

gion’s water is assigned to irrigation of agricultural crops in both Israel and the West Bank (Becker and Zeitouni, 1998). Almost 75% of Israeli water resources are used for irrigated agriculture. Nearly half of Israel’s cultivated land and 70% of West Bank settlers’ cultivated land is irrigated. By contrast, all but 6% of Palestinian cultivated land is dependent on rainfall. While agriculture is central to the Palestinian economy, representing >25% of both GDP and employment, it accounts for 4% of Israel’s GDP and 3.5% of its employment. Yet, the Palestinian per capita annual water quantity used for irrigation represents 25% of the corresponding Israeli value (Exh. 6).

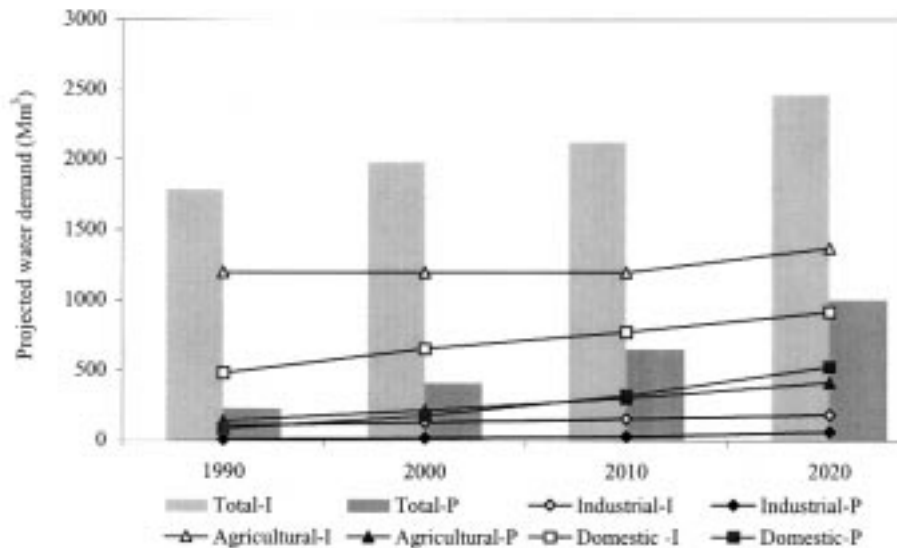
Prospects of substantial increases in water demand in the coming years make it critical to find a solution to water shortage. Israeli and Palestinian populations are both expected to grow significantly (Exh. 7) and population increase is bound to heighten the demand for water (Exh. 8). A *minimum water requirements* analysis reflects a shortage for Palestinians and an excess for Israelis (Exh. 9). Still, the continuing immigration to Israel will result in economic and population growth that will inevitably lead to increased water demand by Israel. Therefore, any moves toward resolution of the Israeli–Palestinian water crisis must account not only for the current hydro-political situation but also for probable future changes in demand. The Mountain Aquifer as well as other shared water resources must be allocated properly to maintain sustainable de-

velopment. Note that the major portion of the region’s water is assigned for irrigation. In fact, the Israeli–Palestinian water crisis is often described as one concerning water for agricultural use. In the West Bank, population increase combined with limited water resources has, to a certain extent, forced a shift of water consumption from agricultural to domestic use. On the other hand, the pricing system in Israel traditionally has supported and still supports agricultural activities through subsidizing irrigation water prices (Becker and Zeitouni, 1998).

As depicted in Exh. 8, the projections for Palestinian domestic water demand assume a relatively high population growth and a decrease in the restrictions imposed on water resources, leading to a higher per-capita water demand. For Israel, per-capita water supply for the domestic sector is adequate. The projected increase in Israeli domestic water demand is the result of an expected rise in population induced by immigration. For the Palestinian industrial sector, the projections are based on the premise that tourism and construction will prosper due to the ending of the occupation. Water demand for this sector is thus expected to continue to increase. As for the agricultural sector, the assumption that the Palestinians will irrigate areas well suited for irrigation in addition to those currently irrigated by the settlers explains the projected increase in water demand for irrigation. In turn, the increase in Israel’s irrigation water demand is dependent upon the extent to which



**Exh. 7. Population growth projections for Israel and the West Bank (Isaac and Selby, 1996).**



Exh. 8. Projected water demand for Israelis (I) and Palestinians (P). (Alatout, 2000; Lithwick, 2000).

new irrigation technologies are adopted and the extent to which prices reflect the true cost of the water (Isaac and Selby, 1996). Although Israel has been able to improve water usage efficiency,<sup>3</sup> it still faces the challenge of reducing the share of its agricultural sector of water, the largest consumer of water (Lithwick, 2000).

#### WATER CONFLICT AND INTERNATIONAL LAWS

Ideally, water conflict resolution should be achieved by the application of international water laws, which address the fundamental interests of the international community, namely, maintenance of international peace and security; development of friendly relations among nations; achievement of international cooperation on problems of an economic, social, cultural, or humanitarian nature; sovereign equality of all member states; and peaceful settlement of disputes. International water laws have evolved mainly for solving issues concerning surface water. While they are sufficiently flexible to be adapted to the particular requirements of ground water issues in different locations, laws on international ground water are in the early stages of development. This is probably due to a lack of scientific data and knowledge of the geo-hydrology, as well as the complex hydro-political issues involved in many parts of the world. The application of international laws is hindered by their ambiguity and by the fact that they can easily be rendered impotent when a state ignores, or is not party to, the laws in question.

International ground water laws currently in use were formulated by the International Law Association and the International Law Commission (Berberis, 1991; Haston and Utton, 1989). They include the Helsinki Rules (1966), the Bellagio draft treaty (1989), and the Seoul Rules (1986) (Exh. 10). None of these rules are binding in international law. They are simply articles that have been adopted by the International Law Association.

<sup>3</sup> Israel and Palestine have among the most efficient irrigation systems in the world through the use of micro-irrigation, which is applied in about 40% of irrigated areas in the West Bank and 50% of areas in Israel (Isaac and Selby, 1996).

While geography and hydrology principles of the Helsinki Rules provide a legitimate basis for a Palestinian to claim sovereignty over West Bank waters (since the majority of the aquifer drainage and recharge area are in the West Bank), Israelis argue that current utilization of water must be distributed in accordance with the second principle of the Helsinki Rules, namely that “prior use determines water rights.” Israel has honored prior use water rights of Palestinians but appropriated all of the ground water that was not being exploited in 1967. Israel is also keen to emphasize the economic and social damage it would suffer if its water allocations were reduced. From a Palestinian perspective, the expected population growth will lead to increased water stress since the Mountain Aquifer is the only source of available water in the West Bank. This is aggravated because current allocation of water resources is insufficient for Palestinian economic and social development.

#### WATER AND THE PEACE PROCESS

In the peace process, Israel seeks to protect its historical water supply and Palestine wants to increase its available water supply and establish its water rights in the West Bank. The Israeli–Palestinian DOP was followed by three agreements: (i) the Gaza–Jericho Agreement (also called Oslo I) signed on 4 May 1994; (ii) the Agreement signed on 29 Aug. 1994 preparing for transfer of power and responsibilities to the Palestinians; and (iii) the Israeli–Palestinian Interim Agree-

Exhibit 9. Estimated ability of water resources to meet minimum water requirements (MWR) for survival at 125 m<sup>3</sup>/person per yr for domestic–urban–industrial use and the cultivation of fresh vegetables (Shuval, 1994).

	Population		Water resources potential million m <sup>3</sup> /yr	Total water		Total MWR 2023 million m <sup>3</sup> †	Total excess short
	1993	2023		1993	2023		
	— millions —		million m <sup>3</sup> /yr	m <sup>3</sup> /capita per yr		— million m <sup>3</sup> † —	
Israel	5	10	1500	300	150	1250	+250
Palestinians	2	5	200	100	40	625	-425

† Based on 125 m<sup>3</sup>/person per yr.

**Exhibit 10. Major principles of international ground water laws (Berberis, 1991; Haston and Utton, 1989).**

International rules	Major principles
Helsinki Rules (1966)	The resolution of a conflict depends on: <ul style="list-style-type: none"> <li>•Geography† and hydrology of the basin‡</li> <li>•The past utilization of the basin waters</li> <li>•Availability of other water resources</li> <li>•The economic and social needs of the basin states</li> <li>•The population dependent on the basin waters</li> </ul>
Bellagio Treaty (1989)	<ul style="list-style-type: none"> <li>•Ensuring reasonable and equitable development and management of ground water</li> <li>•Attaining optimum utilization and conservation of trans-boundary ground water</li> <li>•Developing reliable data to rationally use and protect the ground water</li> </ul>
Seoul Rules (1986)	<ul style="list-style-type: none"> <li>•Basin states should prevent the pollution of international ground water</li> <li>•Basin states should consult and exchange available information and data</li> <li>•Basin states should cooperate for the purpose of collecting and analyzing additional needed information and data</li> </ul>

† Such as the drainage area in the territory of each basin state.

‡ Such as the contribution of water by each basin state.

ment on the West Bank and Gaza Strip (also called Oslo II) signed on 28 Sept. 1995 (Sosland, 1998).

In the DOP, Palestinians and Israelis established preconditions for further negotiations. In this agreement, the Israelis allocated water rights for the Palestinians without a clear indication of the extent to which water should be under Palestinian control during the interim period. The DOP, however, implicitly recognizes the existing inequality in water allocations.

The Oslo II agreement provided the Palestinians with additional water for domestic purposes (28 million m<sup>3</sup>/yr) and guaranteed that all measures will be taken “to prevent any harm to water resources including those utilized by the other side.” Oslo II defined the existing extractions and estimated the potential of the West Bank aquifers (Exh. 11). In the Final Status negotiations, the equitable utilization of joint water resources and the control over land and water are to be resolved.

**THE DECISION**

A delicate conflict over the control and equitable allocation of the Mountain Aquifer water is impeding the Palestinian–Israeli peace process. The Palestinians consider the current water allocation to be inequitable, while the Israelis claim to have priority due to historic water use patterns. Based on the information provided, the JWC must decide upon a mutually acceptable, shared water allocation arrangement. Taking into consideration both the Israeli and Palestinian perspectives, current constraints, and imminent future shortages, what should the committee members decide to ensure the approval of their respective constituency?

**Exhibit 11. Existing extractions and estimated potential of the Mountain Aquifers (Sosland, 1998).**

	Eastern Basin	Northern Basin	Western Basin
	million m <sup>3</sup> /yr		
Palestinians	54	42	22
Israelis	40	103	340
Quantities to be developed	78	--	--
Total	172	145	362

**TEACHING NOTE**

**Case Objectives**

This case study presents one of the most controversial issues in recent Middle Eastern history. Upon completion of the case, students will have:

1. Enhanced their objectivity in tackling sensitive socio-political water resources issues.
2. Understood the magnitude and dimension of the various aspects of water conflict in the framework of the overall Israeli–Palestinian political conflict.
3. Recognized the interrelation between natural resources and politics.
4. Become familiar with the main themes of international law for water conflict resolution.
5. Analyzed and evaluated alternatives for water conflict resolution.

**Uses of the Case**

While this case study was developed for senior and graduate-level students in natural or water resources studies, it can easily be used at other levels for students in political sciences, social studies, agricultural sciences, or related fields. Students will use decision-making skills to integrate primarily the scientific and socio-political components of the case. The case, based on region-specific data and events, provides students an opportunity to evaluate water resources management in a water-scarce region. Social and political considerations play a major role in this case due to the historical and long-standing conflict between the populations involved.

**Implementation of the Case**

Given the sensitive socio-political aspects of the case, scientific objectivity is necessary in the implementation of this case. It is helpful if students are briefly exposed to the history of the Israeli–Palestinian political conflict before using the case. Many books have been written in this regard and much information can be found on the Internet. Shashaa (2000) is a recent example. The case was used in a graduate-level course on environmental case studies and conflict resolution at the American University of Beirut. The class was composed primarily of environmental science students with diverse backgrounds (chemistry, geology, physics, civil engineering, ecosystem management, and environmental education). Invariably, the feedback of students was important and, in fact, their input was used to improve on the case and refine certain questions.

Case studies can be used in a variety of ways in a classroom setting (Herreid, 1994);<sup>4</sup> however, the implementation should be appropriate to the background of the students and the objectives of the course. This particular case lends itself to role-

<sup>4</sup> (i) assigned as outside reading followed by a general class discussion with a decision that needs to be reached with the corresponding justification; (ii) written reports could be required for grading purposes and after correction of the reports, answers can be discussed in class in the context of actual events and what the final decision could be; (iii) the case can be read in class (about a 3-h class; the case would be too long for a 1-h session) followed by either small group or whole class discussion of all or selected questions. The latter approach requires the least amount of class time, but it also provides less chance for students to reflect on the issues of the case.



playing whereby students assume the role of opponents or supporters of Israeli or Palestinian views. An outside panel totally unfamiliar with the case could be invited in to listen to the debate and make a decision based on the arguments presented by the students. Role-playing offers the advantage of nurturing analytical skills, practicing public speaking, and developing awareness of socio-economic, political, and cultural constraints.

## DISCUSSION QUESTIONS AND ANSWERS

### 1. How are water scarcity issues generally approached?

Water scarcity in this region can be organized into five main themes: security, economy, legal, technological, and environmental (Dolatyar and Gray, 2000a).

First, water is often considered to be a source of power. It is a critical and highly strategic issue, which affects the social and economic development of nations, and consequently threatens to undermine their political power. In this context, Israelis have historically perceived the Palestinians as a threat and the support of neighboring Arab countries has only deepened their sense of insecurity. As a result, Israelis resort to maintaining a military edge to successfully ensure control over water resources in the region.

Second, economists often argue that water scarcity is basically an economic problem, which will be alleviated if nations treat water as an economic asset (i.e., through market mechanisms). Water marketing may be problematic for agricultural workers, particularly Palestinians who are relatively poor. The establishment of free markets in the near term can exacerbate instability, as it might be perceived as unfair for Palestinians because of the large economic discrepancy between Israelis and Palestinians.

Third, the absence of proper international agreements between the two populations, which clearly define the system of property rights, can indeed be considered as the root cause of the water crisis. Successful resolution should result in the establishment of water rights at the national, as well as the international level. In this context, the Palestinians feel that they are not negotiating on an equal footing with the Israelis. While Israel is a sovereign state with worldwide recognition (with the exception of several Arab countries, that remain at conflict with Israel), the Palestinian territory is not yet recognized as a sovereign country, not to mention the dramatic imbalance in military and economic power between the two.

Fourth, some optimists claim that water scarcity problems are best solved by better technological management of water resources arguing that such advances would eliminate the possibility of occurrence of shortages. Israelis have pioneered technological advances in irrigation systems, while Palestinians still rely on outdated and inefficient practices as a result of economic damages caused by the Israeli occupation. Palestinians are at a disadvantage in applying advanced water resources management techniques.

Finally, water crises can be viewed as part of larger environmental management crises. The notions of limits to growth, sustainable development, and environmental security are introduced in this last approach. From this perspective, water scarcity is an environmental problem that can be attributed to nonsustainable exploitation practices. The practice of resorting to military, economic, legal, or technological solutions not

only cannot solve the problem but also exacerbates the predicament. The solution is to understand the limits to growth of the eco-geographical regions and adopt rational and sustainable policies within the context of overall conflict resolution.

**2. How can the political conflicts between Israelis and Palestinians be traced back to the conflict around water resources?** Although primarily political in their nature, the various conflicts in the Final Status Negotiation between Israel and Palestinians can be linked to conflicts over water.

1. *The return of the Palestinian Refugees.* While the UN resolution 194 (December 1948) stated clearly the right of the refugees to return to their homes, Israel constantly resists the return of the refugees. In addition to the legal, political, demographic, and economic implications, the return of the refugees will increase the Palestinian population, which can be used as an argument for demanding a higher allocation of the shared water resources such as the Mountain aquifer.

2. *The final borders between Israel and the new Palestinian state.* Setting the border of the Palestinian State has its implication on water resources distribution. In effect, the expansion or shrinking of the border of the proposed Palestinian State can imply an increase or decrease in water resources allocated to Palestinians. For instance, the western side of the Jordan River is currently under Israeli control. The adoption of this river as a border for the new Palestinian state might limit Israeli usage of this source.

3. *The sovereignty of the Palestinian state.* A decision on the extent of sovereignty that the Palestinian state will have can affect water allocation. For instance, if this state will have the full authority for deciding on building reservoirs for water catchment, this could affect aquifer recharge and hence Israeli share of the aquifer water.

4. *The status of East Jerusalem.* The sovereignty over East Jerusalem has its implication on water management. If Israel continues to control East Jerusalem, it will be responsible for providing water to Palestinians residing there. This water might be deducted from the Palestinians share of water resources.

5. *The disposition of the settlers in the West Bank.* The fate of the settlers in the West Bank could affect water allocation. Historically, the settlers had high water consumption due to subsidized agricultural activities. For instance, settlers use up to 60% of the water from the Eastern aquifer, which is entirely within the West Bank. If settlers continue to reside in the West Bank, the share and source of their water supply have to be examined.

### 3. Do you think that a comprehensive treaty that satisfies both Israelis and Palestinians can be reached?

Throughout history, the fair division of water between nations has been constantly impeded by the conflicting interests of coriparian actors. In real life cases, the dominant country in the basin has imposed a solution that best suits its interests. However, some attempts at solving water conflicts have resulted in comprehensive rules, the most common are the Helsinki and ILC rules, which consider several factors (i.e., drainage basin area, population, climate, dependence on water) to distribute water among riparian states in an equitable manner.

### 4. Based on international water laws, what argument may be presented by each party in defending its water

**Exhibit 12. Israeli and Palestinian perspectives of water rights of the Mountain Aquifer.**

Factor	Israeli perspective	Palestinian perspective
Geography and hydrology	<ul style="list-style-type: none"> <li>•Most of the optimal pumping area lies under Israeli territory (natural historical outlet).</li> <li>•The source of a trans-boundary body of water is not the sole criterion in determining water rights.</li> </ul>	<ul style="list-style-type: none"> <li>•80 to 90% of the Mountain Aquifer flow is derived from rainfall over the West Bank.</li> <li>•The majority of the mountain aquifer lies within the West Bank territory.</li> </ul>
Historic use	<ul style="list-style-type: none"> <li>•Israel inherited water resources that had been under British mandate control.</li> <li>•For more than 60 yr, the Israelis have been developing and fully utilizing major portions of the aquifer flow.</li> </ul>	<ul style="list-style-type: none"> <li>•Palestinians are the indigenous inhabitants of the region and are therefore the party with historical prior use rights.</li> <li>•Stringent occupation policies prevented Palestinians from exploiting the ground water of the West Bank.</li> <li>•Israel has violated the Geneva Convention and misused its authority as the occupier by developing many new water supplies in the West Bank.</li> </ul>
Resource availability	25.3% of Israeli water is derived from the West Bank.	The Mountain aquifer is the only source of fresh water.
Economic and social needs	<ul style="list-style-type: none"> <li>•Reducing the current water allocation would cause social and economic damage.</li> </ul>	<ul style="list-style-type: none"> <li>•The contribution of agriculture, the major water-consuming sector, to Israeli GDP and employment is minimal compared with its contribution to Palestinian GDP and employment.</li> <li>•Palestinians need water to build industry and agriculture.</li> <li>•In the past, Israel has allocated insufficient amounts of water for Palestinian urban, industrial, and agricultural development.</li> </ul>
Population	<ul style="list-style-type: none"> <li>•The Israeli population is almost double the Palestinians, which should give them higher share of the water source.</li> </ul>	<ul style="list-style-type: none"> <li>•Israel has a higher population relative to Palestinian population because they are encouraging mass immigration of Jews while restricting the return of Palestinian refugees to their homeland.</li> </ul>
Equitable use of water	<ul style="list-style-type: none"> <li>•Water supplied to Palestinians is enough to meet their needs.</li> </ul>	<ul style="list-style-type: none"> <li>•Water level consumption in 1992 reflects a 4:1 ratio in per capita use in favor of Israeli settlers. The current water available to Palestinians fails to meet their minimal requirements for social and economic well-being.</li> <li>•80 to 90% of aquifer renewable water supply is extracted from deep wells mainly by Israelis.</li> </ul>
Preventing environmental damage	<ul style="list-style-type: none"> <li>•Israel fears that any major unregulated increase in pumping from the Mountain Aquifer in the West Bank area would result in a drastic reduction of Israel's source of drinking water.</li> <li>•Israelis are concerned about the degradation of water quality resulting from inadequate Palestinian control of urban pollution, municipal wastewater, industrial, and agricultural waste.</li> </ul>	<ul style="list-style-type: none"> <li>•Israeli drilling of new deep wells within the West Bank is thought to have caused the drying of traditional springs and shallow wells in the West Bank.</li> </ul>

**rights?** Although the international law of water resources has not yet reached the level of maturity and sophistication, which is desirable given the urgent nature of water problems in many parts of the world, important basic principles and rules have evolved. Israeli and Palestinian perspectives in defending their water rights and respective positions are depicted in Exh. 12.

**5. What are general water management strategies that could be adopted to alleviate water resource constraints?** Management strategies include decreasing demand and increasing supply. Demand could be decreased by controlling population growth, water rationing, increasing public awareness about the scarcity of water resources, water pricing reforms, and increasing the efficiency of water use especially in agriculture (drip irrigation, shift to drought resistant and salinity resistant crops, shift from open drainage to open ground pipes). Increasing the water supply includes reverting to unconventional water sources such as wastewater reclamation, desalinization of sea water and brackish ground water, and rain water harvesting. For instance, in Bogor, Indonesia, household water demand decreased by 30% as a result of increasing water tariff from 0.15 to 0.42 USD/m<sup>3</sup> (Dinar et al., 1997).

**6. What are the available alternatives for solving the Israeli–Palestinian conflict over the Mountain Aquifer shared water resources?** A successful approach for solving the Palestinian–Israeli water conflict must incorporate a balance among three elements:

- Allocation of available water supplies based on an agreement between both parties on the sovereignty over water re-

sources in the West Bank as well as the rightful allocation of the shared water.

- Demand management including conservation and appropriate utilization of water supplies such as monitoring for leakage to minimize water losses in the distribution system and improving the efficiency of existing irrigation systems.
- Enhancement of existing water supplies either through increasing unconventional sources (e.g., water desalination, wastewater reclamation, import of water) or reducing demand (e.g., water pricing) or a combination of both.

This approach for the resolution of the Mountain Aquifer conflict should be an inseparable part of the broader framework for resolving the Jordan River basin conflict. The later is best attained through a comprehensive and integrated regional plan for cooperation on water resources. This should involve negotiations among multiple parties (Jordan, the Palestinian Authority, Syria, Lebanon, and Israel) to reach an agreement on equitable utilization and protection of water resources in the basin region. The agreement should also establish an institution for the joint management of the water resources. Then, each riparian state would have to reinforce its legislation on water issues to be able to implement the remaining components of the regional plan, including water demand and supply management along with public awareness campaigns on regional water issues. Possible components, objectives, and their implementation are summarized in Exh. 13. This approach is considered comprehensive and integrated because it links the political, technical, socio-economic, environmental, infrastructural, and other aspects of water resource management.

### Exhibit 13. Integrated regional water resource management plan.

Component	Objective(s)	Implementation
1. Negotiating agreements.	<ul style="list-style-type: none"><li>•To allow cooperative water management plans and equitable water allocation of both surface and ground water resources (Berman and Wihbey, 1999).</li><li>•To promote regional water security and alleviate the fear among the riparians of the Jordan River basin (Berman and Wihbey, 1999).</li></ul>	<ul style="list-style-type: none"><li>•By adopting a regional water charter for distributing water rights equitably among the riparian states according to the international law principle of human conditions (Benvenisti, 1994; Haddad and Mizyed, 1996).</li><li>•By adopting a political–military framework on water issues through the formal signing of a memorandum on collaborative ventures such as the mutual defense of regional water supplies by military coordination and banning the destruction or contamination of water supplies and facilities (Benvenisti, 1994; Haddad and Mizyed, 1996).</li></ul>
2. Creating a specialized institution for the joint management of both surface and ground water resources.	<ul style="list-style-type: none"><li>•To achieve a harmonious and optimal exploitation of shared water resources and to facilitate the resolution of any future conflict (Haddad and Mizyed, 1996; Kliot and Shmueli, 1998; Mostert, 1998).</li><li>•To prevent uncontrolled digging of wells and over abstraction of aquifers (Kliot and Shmueli, 1998; Nasser, 1996).</li><li>•To build a regional database that will aid in responding to emerging water conditions and changes (Kliot and Shmueli, 1998; Nasser, 1996).</li><li>•To set water quality standards (Kliot and Shmueli, 1998; Nasser, 1996).</li><li>•To manage the regional sharing of information on environmental conditions and technological breakthroughs (Kliot and Shmueli, 1998; Nasser, 1996).</li></ul>	<ul style="list-style-type: none"><li>•By developing a permit system and the installation of meters on every well (Nasser, 1996).</li><li>•By collecting, assessing, and analyzing data and transforming hydrological and water data into information for planning, decision making, and operation of sound management systems (Nasser, 1996).</li></ul>
3. Implementing legislative and institutional reforms (Haddadin, 1996).	<ul style="list-style-type: none"><li>•To monitor and enforce the laws, agreements, rules, and standards, especially those to be adopted in the regional water plan (Haddadin, 1996).</li></ul>	<ul style="list-style-type: none"><li>•By the improvement and reinforcement of the water sector institutions in each of the riparian states (Haddadin, 1996).</li></ul>
4. Harmonizing water pricing and cost recovery policies among the riparian states (Haddad and Mizyed, 1996).	<ul style="list-style-type: none"><li>•To recover operation and maintenance costs in addition to a portion of the investment costs (Haddadin, 1996).</li><li>•To encourage efficient resource utilization (Haddadin, 1996).</li></ul>	<ul style="list-style-type: none"><li>•By establishing cooperative water policies among the riparian states (Haddadin, 1996).</li></ul>
5. Optimizing water use in all riparian states through exchanging water demand management experiences (Arlosoroff, 1996).	<ul style="list-style-type: none"><li>•To reduce water demand, which will lessen the problem of water scarcity and in turn reduce the likelihood and intensity of possible water conflicts (Arlosoroff, 1996).</li></ul>	<ul style="list-style-type: none"><li>•By increasing the efficiency of irrigation systems (i.e., drip, sprinkler, and automation) (Arlosoroff, 1996).</li><li>•By reclaiming industrial effluents (most probably for irrigation purposes) and adopting water saving efforts (cascading changes and cooling methods) (Arlosoroff, 1996).</li><li>•By conserving water at the municipal level through decreasing losses due to unaccounted-for-water and utilizing demand reducing kits such as toilet flush reduction, regulated showerheads, two-volume flushing, flow regulators in kitchen and bathroom sink taps, leakage control, and technologies for improving garden and park irrigation (Arlosoroff, 1996).</li></ul>
6. Selecting regional water supply development projects (Arlosoroff, 1996).	<ul style="list-style-type: none"><li>•To augment irrigation, industrial, and municipal water supplies.</li></ul>	<ul style="list-style-type: none"><li>•Water harvesting through constructing micro-scale dams and aquifers to collect the rainfall and storm runoff could increase water supplies to Jordan, Israel, and the Palestinian Authority by 5% (Berman and Wihbey, 1999).</li><li>•By re-using municipal wastewater and brackish water for irrigation purposes (Arlosoroff, 1996).</li><li>•By desalination of brackish and seawater, which, in spite of its relatively high cost, could be relied upon for augmenting municipal and industrial supplies.</li><li>•By developing inter-basin water transfer projects such as the Jordanian water transfer from Azraq to Amman and the Israeli National Water Carrier (Haddadin, 1996).</li></ul>
7. Enhancing regional public awareness campaigns (Haddadin, 1996; Nasser, 1996; Stout, 1994).	<ul style="list-style-type: none"><li>•To expand the knowledge base of decision-makers for achieving wise natural resources management (Haddadin, 1996; Nasser, 1996; Stout, 1994).</li><li>•To convince the population of the region that water resources are scarce and that water should be regarded as a commodity (Haddadin, 1996; Nasser, 1996; Stout, 1994).</li><li>•To expose the population to the cost of producing, treating, and distributing water to achieve wise water utilization (Haddadin, 1996; Nasser, 1996; Stout, 1994).</li></ul>	<ul style="list-style-type: none"><li>•By conducting public awareness and media campaigns, and specialized seminars (Haddadin, 1996; Nasser, 1996; Stout, 1994).</li></ul>

### ACKNOWLEDGMENTS

Special thanks are extended to the U.S. Agency for International Development for its continuous support for the Environmental Engineering and Sciences Programs at the American University of Beirut.

### REFERENCES

Alatout, S. 2000. Water balance in Palestine: Numbers and political culture in the Middle East. p. 59–84. *In* D.B. Brooks and O. Mehmet (ed.) *Water*

balance in the eastern Mediterranean. IDRC (International Development Research Center), Ottawa, ON, Canada.

Arlosoroff, S. 1996. Managing scarce water: Recent Israeli experience. p. 21–48. *In* J.A. Allan (ed.) *Water, peace and the Middle East: Negotiating Resources in the Jordan Basin*. Taurus Academic Studies, New York.

Awartani, H. 1994. A projection of the demand for water in the West Bank and Gaza Strip, 1992–2005. p. 9–31. *In* J. Isaac and H. Shuval (ed.) *Water and peace in the Middle East*. Elsevier Science B.V., the Netherlands.

Becker, N., and N. Zeitouni. 1998. A market for the Israeli–Palestinian water dispute. *Water Int.* 23:238–243.

- Benvenisti, E. 1994. International law and the Mountain Aquifer. p.229–238. *In* J. Isaac and H. Shuval (ed.) *Water and peace in the Middle East*. Elsevier Science B.V., the Netherlands.
- Berberis, J. 1991. The development of international law of transboundary groundwater. *Nat. Resour. J.* 31:167.
- Berman, I., and P.M. Wihbey. 1999. The new water politics in the Middle East [Online]. [11 p.] Available at: <http://www.israeleconomy.org/strategic/water.htm> (verified 12 June 2001). The Inst. for Advanced Strategic and Political Studies, Jerusalem, Israel.
- Central Intelligence Agency. 2000a. The world factbook 2000: Israel. [Online]. [10 p.] Available at: <http://www.cia.gov/cia/publications/factbook/geos/is.html> (verified 12 June 2001). CIA, Washington, DC.
- Central Intelligence Agency. 2000b. The world factbook 2000: West Bank. [Online]. [7 p.] Available at: <http://www.cia.gov/cia/publications/factbook/geos/we.html> (verified 12 June 2001). CIA, Washington, DC.
- Dinar, A., M.W. Rosegrant, and R.Meinzen-Dick. 1997. Water allocation mechanisms: Principles and examples. World Bank, Washington, DC.
- Dolatyar, M., and T.S. Gray. 2000a. Five approaches to water scarcity. p. 15–59. *In* *Water politics in the Middle East*. Macmillan Press Ltd., UK.
- Dolatyar, M., and T.S. Gray. 2000b. Water politics in the Jordan River basin. p. 88. *In* *Water politics in the Middle East*. Macmillan Press Ltd., UK.
- Farinelli, X.H. 1997. The prevention of freshwater conflicts: The case of the Jordan River [Online]. [11 p.] Available at: <http://www.gci.ch/Green-CrossPrograms/waterres/gcwater/jordan.html> (verified 12 June 2001). Green Cross Int., Geneva, Switzerland.
- Haddad, M., and N. Mizyed. 1996. Water resources in the Middle East: Conflict and solutions. p. 3–17. *In* J.A. Allan (ed.) *Water, peace and the Middle East: Negotiating resources in the Jordan basin*. Taurus Academic Studies, New York.
- Haddadin, M.J. 1996. Water management: A Jordanian viewpoint. p. 59–73. *In* J.A. Allan (ed.) *Water, peace and the Middle East: Negotiating resources in the Jordan basin*. Taurus Academic Studies, New York.
- Haston, R., and A. Utton. 1989. Transboundary groundwater: The Bellagio draft treaty. *Nat. Resour. J.* 26:663–722.
- Herreid, C.F. 1994. Case studies in science: A novel method of science education. *J. College Sci. Teaching* 23:221–229.
- Isaac, J., and J. Selby. 1996. The Palestinian water crisis: Status, projections and potential for resolution. *Nat. Resour. Forum* 20:17–26.
- Kliot, N., and D. Shmueli. 1998. Real and ideal frameworks for managing the common Arab–Israeli water resources. *Water Int.* 23:216–226.
- Libiszewski, S. 1995. Water disputes in the Jordan basin region and their role in the resolution of the Arab–Israeli conflict. ENCOP Occasional Pap. 13. Center for Security Policy and Conflict Research, Zurich; Swiss Peace Foundation, Berne. [Also available online at: <http://www.fsk.ethz.ch/encop/13/en13.htm> (verified 12 June 2001).]
- Lithwick, H. 2000. Evaluating water balances in Israel. p. 29–58. *In* D.B. Brooks and O. Mehmet (ed.) *Water balance in the Eastern Mediterranean*. IDRC (International Development Research Center), Ottawa, ON, Canada.
- Morris, M.E. 1998. Water scarcity and security concerns in the Middle East. The Emirates Occasional Papers, The Emirates Center for Strategic Studies and Research, Dubai.
- Mostert, E. 1998. A framework for conflict resolution. *Water Int.* 23:206–215.
- Nasser, Y. 1996. Palestinian management options and challenges within an environment of scarcity and power imbalance. p. 49–57. *In* J.A. Allan (ed.) *Water, peace and the Middle East: Negotiating resources in the Jordan Basin*. Taurus Academic Studies, New York.
- Rosegrant, M.W. 1995. IFPRI: 2020 Brief 21: Dealing with water scarcity in the next century. [4 p.] [Online]. Available at: <http://www.ifpri.cgiar.org/2020/briefs/number21.htm> (verified 12 June 2001). Int. Food Policy Res. Inst., Washington, DC.
- Shashaa, E. 2000. Ancient history of Palestine [Online]. [5 p.] Available at: <http://www.palestinehistory.com/text/palst.htm> (verified 1 June 2001). United Arab Emirates, Sharjah.
- Shuval, H. 1994. Proposals for the integrated management of the shared transboundary water resources of the Jordan River basin. *Water Sci. Technol.* 30(9):187–193.
- Shuval, H. 1996. Towards resolving conflicts over water between Israel and its neighbours: The Israeli–Palestinian shared use of the Mountain Aquifer as a case study. p. 75–119. *In* J.A. Allan (ed.) *Water, peace and the Middle East: Negotiating resources in the Jordan Basin*. Taurus Academic Studies, New York.
- Sosland, J.K. 1998. Cooperating rivals: The politics of water scarcity, protracted conflict, and complex cooperation in the Jordan River Basin. Ph.D. diss. Faculty of the Graduate School of Arts and Sciences, Georgetown Univ., Washington, DC.
- Stout, G.E. 1994. Vision can make a difference: Transboundary issues. p.1–6. *In* J. Isaac and H. Shuval (ed.) *Water and peace in the Middle East*. Elsevier Science B.V., the Netherlands.
- United Nations. 1992. Water resources in the Occupied Palestinian territories. A/AC/183/. The Committee on the Exercise of the Inalienable Rights of the Palestinian People, United Nations, New York.
- Wolf, A. 1993. Principles for confidence-building measures in the Jordan River watershed. *In* I. Kobori and M.H. Glantz (ed.) *Central Eurasian water crisis: Caspian, Aral, and Dead Seas*. The United Nations Univ., Tokyo, Japan. [Also available online at: <http://www.unu.edu/unupress/unupbooks/uu18ce/uu18ce00.htm#Contents> (verified 12 June 2001)].
- Wolf, A., and J. Ross. 1992. The impact of scarce water resources on the Arab–Israeli conflict. *Nat. Resour. J.* 32:919–958.
- Zarour, H., and J. Isaac. 1991. The water crisis in the Occupied Territories. Presented at the 7th World Conf. on Water, Rabat, Morocco. 13 May 1991. Rabat, Morocco.