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## ***The essentials of sustainable water resource management in Israel and Palestine***

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### **Abstract**

Water is recognized as a nascent source of conflict between Israel and its neighbors especially Palestinians, who are facing an acute water crisis not because of the area's arid conditions but primarily because of the abnormal political conditions caused by Israel's control over the Palestinian groundwater and surface water resources. Israel is currently utilizing more than 80 % of the Palestinian groundwater resources and denying Palestinians their rightful utilization of the Jordan River. Palestinians are currently allocated 87 MCM per year for domestic and Industrial use leaving the per capita consumption under suppressed demand at an average of 30 m<sup>3</sup>/year, which is far below the required standards of water supply. For agriculture, Palestinians have access to 151 MCM per year which they are using to irrigate around 11 % of their cultivated lands while Israel is enjoying abundant water to irrigate 62 % of its cultivated land. The current water allocations came about as a result of fete compli arrangements reflecting the balance of power rather than internationally formulated agreements

According to Oslo II agreement, Israel recognized the Palestinian water rights, but these are to be negotiated in the permanent status negotiations. However, so far, no negotiations have taken place to enumerate the Palestinian water rights. The issue of Palestinian water rights will be one of the most difficult issues in the final status negotiations. The Oslo II agreement included arrangements for delivering an additional 28.6 MCM for the Palestinians to meet their immediate needs for domestic water use during the interim period. Regrettably, only 7 mcm of additional water has reached the Palestinians which is not enough to meet the growing needs of the population which is still experiencing water shortages.

Israelis and Palestinians should immediately and forcefully adopt a holistic approach in addressing their water conflict. The interdependency between water management and environmental protection, social progress and economic growth is clear and necessitates joint water management schemes which will ensure equity in water accessibility to both



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Palestinians and Israelis. Unless these issues are addressed immediately and properly according to international norms that will translate into actual water in their pipes, Palestinian will remain the thirsty partner in the Middle East with a severe water crisis that will impact the sustainability of the peace process. The paper will address the Israeli-Palestinian water conflict and propose ways and means of resolving it.

## **Introduction**

The current peace process offers a special opportunity for all nations in the Middle East to abandon the existing states of belligerency, confrontation, non-cooperation and polarization. The ultimate objective is to arrive at a comprehensive, just and lasting peace in the whole region where all the peoples of the area can together develop the area and promote progress and prosperity in the region. Water will be a major issue that can catalyze the peace process or inhibit it. After more than five years of meetings and negotiations, the gap in the positions among regional parties is still as wide as ever. The region's hydrologists and politicians are still talking at different wavelengths. This paper will focus on the Israeli Palestinian water disputes in the groundwater aquifers and the Jordan River. We realize that water is a particularly sensitive and critical issue for all parties to the conflicts. But, we also believe that finding a common understanding of water issues in the Middle East would go far to enhance the possibilities of achieving stability in the region. Conversely, failure to reach these common grounds will, most definitely, obstruct any efforts to attain this goal. There is no alternative to an honest and forthright discussion of the water issues and to exposing the current unsustainable reality of mismanagement, inequities, the outright denial of the Palestinians' inalienable right to their resources.

## **Water Resources in Palestine**

Water does not recognize political boundaries and as such, it is quite difficult to delineate Israeli and Palestinian surface and ground water resources.

### ***Surface Water***

Surface water is that which flows permanently in the form of rivers and wadis or that which is held in seasonal reservoirs. The only permanent river which can be used as a source of surface water in Palestine is the Jordan River.

The Jordan river is 360 kms long with a surface catchment area of about 18,300 km<sup>2</sup> of which 2,833 km<sup>2</sup> lie upstream of the lake Tiberias outlet. The average annual flow of this river is about 1311 MCM (Haddad, 1997). The Jordan river initiated from three main springs: the Hasbani in Lebanon, the Dan in occupied Palestine, and the Banias in the Syrian Golan Heights to form the Upper Jordan river basin. The water of this basin flows southward through Lake Hula towards the Lake Tiberias. In the absence of irrigation



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extraction, the Jordan River system would be capable of delivering an average annual flow of 1,850 MCM to the Dead Sea. The riparians of the Jordan River are Lebanon, Syria, Palestine and Jordan. Only three percent of the Jordan River's basin fall within Israel's pre-1967 boundaries.

Average precipitation for Upper Jordan and Lake Tiberias averages 1,600 mm and 800 mm respectively. Lower basin, around the Dead Sea has a desert climate characterized by scarce rainfall. The Jordan River is progressively more saline and less usable towards the Dead Sea. The Jordan River system satisfies about 50% of Israel's and Jordan's water demand; Lebanon and Syria are minor users, meeting 5% of their combined demands via the Jordan.

Downstream of Tiberias is the Lower Jordan river basin which joins Yarmouk and Zerka rivers originating from Syria and Jordan in the east. The outlet of this basin is toward the Dead Sea in the South. As a result of water diversion from the upper Jordan by the Israelis which is approximated to be 685 (Haddad, 1997), there is no fresh water to flow downstream of Tiberias. In normal years Israel allows a flow downstream from Lake Tiberias of just 60 MCM of water basically consisting of saline springs which previously used to feed the lake, and sewage water. These are then joined by what is left of the Yarmouk, by some irrigation return flows, and by winter runoff, adding up to a total of 200-300 MCM. Both in quantity and quality this water is unsuitable for irrigation and does not sufficiently supply natural systems either ([www.fsk.ethz.ch/encop/13/en13-cho.htm](http://www.fsk.ethz.ch/encop/13/en13-cho.htm)).

### *Flood Water Flow*

Surface flood runoff in the West Bank is mostly intermittent and probably occurs when the rainfall exceeds 50 mm in one day or 70 mm on two consecutive days. The runoff is estimated at about 64 MCM/yr in the West Bank (Al-Khatib, 1989; Abu Mayleh, 1991). Streams flowing from the west towards the Jordan Valley recharge shallow aquifers such as Wadi el Qilt, Auja and Wadi Al Far'a (Assaf, 1991). The flood wadis can be divided according to the flood flow direction as follows:

1. The eastern and northeastern flood wadis that have an average total annual flood flow volume of about 18.57 MCM/yr.
2. The western flood wadis that have an average total annual flood flow volume of about 17.91 MCM/yr.

In addition, there are small-scale wadis which discharge a total flood water volume that may reach 15 MCM/yr during the very wet seasons.

In the Gaza Strip, runoff water is collected in small wadis and valleys within the area. Wadi Gaza is the most important one. It drains 3,500 km<sup>2</sup> of the northern Negev. The northeastern part of the Gaza Strip, with loessial and alluvial soils, also contains some wadis. These soils



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have a low infiltration capacity; therefore, there are many surface run-offs during intensive rainfall.

## **West Bank Mountain Aquifer**

The Mountain Aquifer which was called so by Blake and Goldschmidt (1947) includes the area which was controlled by the Jordanian Administration before 1967 and since then became under Israeli Occupation. It is mainly composed of karstic limestone and dolomite formations of the Cenomanian and Turonian ages. It is mostly recharged from rainfall on the West Bank mountains of heights greater than 500 meters above mean Sea level. The annual renewable freshwater water of this aquifer ranges from 600 MCM to 650 MCM according to different Israeli and Palestinian sources. Figure (1) shows the distribution of groundwater basins and aquifers in the West Bank. According to that schematic diagram (Fig.1), the Mountain Aquifer can be divided into three main groundwater basins, each of which can be subdivided into subbasins. There are two general directions for the groundwater of the Mountain Aquifer, east and west. The groundwater basins were recharged directly from rainfall on the outcropping geologic formations in the West Bank mountains (forming the phreatic portion), while the greatest part of the storage areas was located in the confined portions.

The phreatic portions constitute the subsurface area under the West Bank mountains where the Palestinians dug their groundwater wells to tap the shallow unconfined aquifers. The Israelis, however, dug their wells to tap the confined aquifers whose quality and quantity are better. These groundwater basins are:

**Figure 1** Groundwater basins and exposed aquifer systems in Palestine

### *1. The Western Groundwater Basin*

Consisting the western part the Mountain Aquifer, it consists of two subbasins, Nahr el Auja A-Tamaseeh and Hebron- Beer Shava, that drain the Lower and Upper Cenomanian aquifers with a total pumpage and spring discharge ranging from 380-400 MCM/yr. The recharge rate of this basin is range from 340 into 380 MCM/yr (PWA, 1997). About 80% of the recharge area of this basin is located within the West Bank while 80% of the storage area is located within the Israeli borders. The groundwater flow movement is towards the coastal plain in the west. Though, in theory, it is a shared basin between both Israelis and Palestinians, the Israelis have overexploited the basin using 340 MCM, while the Palestinians consumed about 22 MCM for all purposes (PWA, 1997).

### *2. Northeastern Groundwater Basins*

Consisting of the Nablus-Jenin basin that drains the Eocene aquifer and the overlying Samarian basin that drains the Eocene and Neogene Aquifers, the basin's recharge rate is range from 140 into 200 MCM/yr (PWA, 1997). While again this is a shared groundwater



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basin, Israelis consumed about 103 MCM and Palestinians consumed about 42 MCM for both irrigation and domestic purposes from their wells and springs in Jenin district and East Nablus (Wadi El Far'ah - Wadi El Bathan). The general groundwater flow direction is towards the Bisan natural outlets (springs) in the north and northeast.

### *3. Eastern Groundwater Basin*

Constituting the eastern flank of the Mountain Aquifer, the general groundwater flow direction in this basin is to the east (Jordan Valley). The recharge rate of this basin ranges from 100 into 170 MCM/Yr (PWA, 1997). This basin drains the Neogene, Pleistocene, Lower Cenomanian, and Upper Cenomanian Aquifers and can be divided into six subbasins. Although it is an unshared groundwater basin as both recharge and storage areas are located within the boundaries of the West Bank Israelis consumed about 40 MCM and Palestinians consumed about 54 MCM for all purposes (PWA, 1997). It is unexploited completely because of water quality problems in the upper shallow aquifers in which Palestinians dug their wells. It needs extensive hydrogeological study to identify its actual potential resources, safe yield, the hydrogeological properties, groundwater quality, and flow pattern of each aquifer.

### **Gaza Coastal Aquifer**

The main Gaza Aquifer is a continuation of the shallow sandy/sandstone coastal aquifer of Israel (shared aquifer) which is of the Pliocene-Pleistocene geological age. About 2200 wells tap this aquifer with depths mostly ranging between 25 and 30 meters. Its annual safe yield is 55 MCM (GTZ, 1998), but the aquifer had been overpumped since before 1967, resulting in a lowering of the groundwater table below sea level and saline water intrusion in many areas. The main sources of salinity are deep saline water intrusion from deeper saline strata, sea water intrusion, and return flows from very intensive irrigation activities. Since 1967, the aquifer has been overpumped by a rate of 90-100 MCM/Yr in order to meet both Israeli settlers and Palestinian water needs.

In addition to that there are other water sources within the area include; the sea of Gallilee, much of its water which is surface water is delivered directly to the population of settlements in the vicinity via the National Water Carrier. Some additional relatively smaller aquifers are to be found in the Western Galilee, in the Golan, in the northern valleys, in the Jordan Basins and in the Arava desert. Table 1 shows the available water resources in mandate Palestine



**Table 1** Available water resources in mandate Palestine

Source	Total annual recharge (MCM)	Water use (MCM)		
		Palestinian	Israeli	Israeli settlements
<b>Renewable Aquifers</b>				
Eastern aquifer	172	54 (61) <sup>1</sup>	40	35-50
North eastern aquifer	145	42 (32) <sup>1</sup>	103	5
Western aquifer	362	22 (24) <sup>1</sup>	340	10
Coastal Plain Aquifer	240	0		
Gaza Coastal Aquifer	55	112		5-10
Western Galilee	120	0		
Sub-Basins	0-40	0		
Other aquifers	205	0		
<b>Surface Water</b>				
Jordan River basin	1311	0	685	10-20
Surface runoff	90			

Sources: Compiled from various sources including; PWA, 1997. Haddad, 1997, Al Musa, 1997, GTZ, 1998..

<sup>1</sup> Number in parentheses reflect Palestinian withdrawal quantities recorded by the West Bank Water Department for 1995.

### Water Quality

As discussed earlier Palestinian's share in the River's water cannot be used because they have no access to the Jordan River due to military closure by the Israelis since 1967. Different riparians took their needs from the Jordan River basin and the only small quantity that can reach the Palestinian riparian in the West Bank is of deteriorated quality. At present, about 1000 MCM of surface water are developed and used by Israel and Jordan (GTZ, 1998). The salinity of the Jordan River reaches up to 2,000 parts per



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million (ppm) in the lowest section, which is unsuitable for irrigating all crop varieties, especially those that are sensitive to salinity. This deterioration is due to the over-exploitation of the shallow aquifer tapped by Palestinian wells there, scarcity of rainfall and the replenishing of water, as well as the effect of irrigation return flow. The deep Israeli wells in the Jordan Valley have good water quality since they tap another safer aquifer, the Lower Cenomanian aquifer system. The Israelis are currently consuming 40 MCM/yr. (Oslo II, 1995) of water from their deep groundwater wells in the Jordan Valley. On the other hand, the deterioration of water quality in the Palestinian Territories is caused by pollution from the three main sectors: households, agriculture, and industry, in addition to exploitation of water resources. Quality measurements of groundwater in the West Bank, conducted by ARIJ in 1995, have shown that the nitrate level in some areas exceed the permissible level of 45 mg/l (van der Leeden *et al.*, 1991). This is particularly true in Nablus city and the Jericho area. Nitrates in groundwater are an indicator of pollution from fertilizers and/or wastewater.

Furthermore, most of the water extracted from the Gaza aquifers is of poor quality due to high salinity (reaching 1500 ppm in some cases) and the high level of nitrates (reaching more than 350 mg/l) that falling below health standards set by the World Health Organization. However, there are a limited number of water lenses under Gaza which are of freshwater quality. These lenses are situated around the Israeli settlements in the Gaza Strip and thus are not accessible to the Palestinians even after Autonomy. Overpumping of the Gaza aquifers has resulted in seawater intrusion and high salinity levels. In southern Gaza, groundwater salinity has been rising by 20 mg/l/year, and the water table has been declining by about 0.2 m per year (PEPA and Euroconsult/Iwaco, 1995). Chemically contaminated water runoff seeping into aquifers has resulted in high nitrate levels. The same water quality Problem is located in the eastern groundwater basin of the West Bank Mountain aquifer.

### **Roots of the water conflict**

To come up with a solution to the water conflict, it is extremely important to look at its roots, which go back to the end of the past century when the Zionist movement started its plans for creating a Jewish homeland. In 1875, it was proposed that such a homeland should encompass Palestine, the Negev and parts of Jordan with their water resources so it can absorb 15 million Jews. After the declaration of the British Mandate in 1922, the Jewish Agency formed a special technical committee to conduct studies of the utilization of water and irrigation of unarable and desert land. Most of the studies conducted were used to evaluate water plans designed by both the Jewish Agency and the United Nations Partition Plan of Palestine. The Arabs found it imperative to protect their water resources and, thus, began designing their own plans. Rising political tension in the region and the lack of a solution acceptable to all parties exacerbated the situation, which eventually exploded into several rounds of wars between Arabs and Jews.



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Two important water-related events characterize the British Mandate period from 1922 to 1948, namely the Rutenberg Concession and the Ionides Plan. In 1926, the British High Commissioner granted the Jewish-owned Palestine Electricity Corporation, founded by Pinhas Rutenberg, a 70-year concession to utilize the water of the Jordan and Yarmouk Rivers to generate electricity. The concession denied Arab farmers the right to use the water of the Yarmouk and Jordan Rivers upstream of their junction for any reason whatsoever, unless permission was granted by the Palestine Electricity Corporation. In 1937, the government of Great Britain assigned M. Ionides, a hydrologist, to serve as the Director of Development for the East Jordan Government. His actual task was to conduct a study of the water resources and irrigation potentials of the Jordan Valley Basin. This study served as the main reference in the preparation of the proposed United Nations Partition Plan of Palestine. Published in 1939. The Ionides Plan made three recommendations. Firstly, Yarmouk flood waters were to be stored in Lake Tiberias. Secondly, the stored waters in Lake Tiberias plus a block quote quantity of 1.76 CM/s of the Yarmouk River water, diverted through the East Ghor canal, were to be used to irrigate 300,000 dunums of land east of the Jordan River. And finally, the secured irrigation water of the Jordan River System, estimated at a potential of 742 MCM, was to be used primarily within the Jordan Valley Basin. The Jewish agency was not satisfied with the findings and recommendations of Ionides.

Following the 1948 war, Israel launched a Seven Year-Plan aimed at diverting the Jordan River water south toward the Negev desert. In September 1953, the construction of the National Water Carrier began. The diversion originated at the Banat Yacoub Bridge in the demilitarized zone between Israel and Syria. After Arab objection to the excavation process, a temporary freeze on the work was announced and the United States presented a plan as yet another attempt to solve the region's water dispute. The Johnston plan, which was prepared under the supervision of the Tennessee Valley Authority included water distribution quotas for the Jordan Valley Basin, estimated at 1287 MCM annually, among the riparian states as shown in table 2.

**Table 2** Water allocation according to Johnston's Plan of 1955

	<b>First Johnston plan</b>	<b>Revised Johnston</b>	<b>Present use (90's)</b>
Syria	50	132	153
Lebanon	-	35	5-10
Jordan	829	720	255-290
<b>Total Arab states</b>	<b>879</b>	<b>887</b>	<b>413-453</b>
Israel	426	375-475	675-700*

- including water of the West Bank

Source: soffer1992



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The period between October 1953 and July 1955 was a stage of negotiating and bargaining over the allocation of the Jordan River waters. By the end of 1955, the Johnston Plan had become more favourable to Israel, whose share rose to 450 MCM, while Jordan's share dropped to 720 MCM (Becker, 19...). The failure to reach a regional agreement reinforced each country's inclination to proceed independently. In 1958, Israel reinitiated the National Water Carrier project but with some technical changes; also, the Seven-Year Plan was replaced by a Ten-Year Plan. Arab reaction to Israel's National Water Carrier was to build dams on tributaries of the Jordan and Yarmouk Rivers, thus reducing the water flow to Israel. In 1965, Syria began building dams to divert water from the Banias and Dan Rivers in the Golan Heights. Israel sent its fighter planes to destroy the work sites. No regional water plans were devised after the Johnston Plan of 1954, which allocated the water between the riparians based on the irrigable areas within the watershed line. A West Ghor canal was included in his plan to provide Palestinians with Jordan River water that translates into 250 MCM per year. This project was never implemented..

Following the 1967 war, Israel secured its control over the headwaters of the Jordan River. Before 1967, the Palestinians had 720 groundwater wells for agricultural and domestic purposes. Soon after the occupation, Israel imposed a number of military orders to control Palestinian water resources. On August 15, 1967, the Israeli military commander issued Order No. 92, in which water was considered as a strategic resource. This order was followed by numerous other orders aimed at making basic changes in the water laws and regulations in force in the West Bank. Under Military Order No. 158 of 1967, it is not permissible for any person to set up or to assemble or to possess or to operate a water installation unless a license has been obtained from the area commander. This order applies to all wells and irrigation installations. The area commander can refuse to grant any license without the need for justification. These orders were followed by numerous military orders- No. 291, No. 457 of 1972, 484 of 1972, 494 of 1972, 715 of 1977 and 1376 of 1991- to achieve complete control over Palestinian water resources. Immediately after the end of the war, Israel destroyed 140 Palestinian water pumps in the Jordan Valley and made it difficult to obtain permits for new wells. Despite the rapid increase in population and demand on water, Israel, since 1967, has granted Palestinians of the West Bank only five permits for new water wells. All were to be used exclusively for domestic purposes. New water wells for agricultural purposes in the West Bank were also restricted to three permits.

### **Water consumption in Israel and Palestine**

Israel has restricted Palestinian water usage and exploited Palestinian water resources. Presently, more than 85% of the Palestinian water from the West Bank aquifers is taken by Israel, accounting for 25.3% of Israel's water needs. Palestinians are also denied their right to utilize water resources from the Jordan and Yarmouk Rivers, to which both Israel and Palestine are riparians. At present, Israel is drawing an annual 70-100 MCM from



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the Yarmouk, and is piping 1.5 mcm per day from Lake Tiberias in its National Water Carrier (Rudge 1992).

As a result of Israeli policies, Palestinians are permitted to utilize 238 MCM of the water resources to supply 2,895,683 Palestinians in both West Bank and Gaza strip with their domestic, industrial and agricultural needs. For comparison, 5,757,900 Israelis are utilizing 1959 MCM. On a per capita basis, water consumption by Palestinians is  $82 \text{ m}^3$  compared to  $340 \text{ m}^3$  for Israelis. It should be added here that Jewish settlers in both the West Bank and Gaza Strip consume huge amounts of the scarce Palestinian water resources. The 5,500 settlers in the Gaza Strip consume 10 MCM/yr for all purposes, whereas the one million Palestinians within Gaza consume approximately 113 MCM/year (Nassereddin, 1997). In the West Bank, Jewish settlers are consuming 57.3 MCM per year (PWA, 1997). While Palestinians are struggling to connect the remaining 25% of the Palestinian population to household water-distribution systems. Jewish settlers in the West Bank and Gaza Strip receive continuous water supply, largely from groundwater wells in the Palestinian Territories.

In both Palestine and Israel, the agricultural sector uses about 2-3 times of the municipal water consumption. While the agricultural sector in Palestine contributes between 15 and 20 % of the GDP, it contributes only 1.8% to the GDP in Israel. Irrigated area in the Palestinian Territories covers approximately 201,358.00 dunums, of which 94,727.5 dunum located in the West Bank, mainly in the Jordan Valley, Jenin, and Tulkarm areas. On the other hand, the irrigated area in Israel is 2,177,500 dunums and mainly located in Jordan Valley (ARIJ GIS, 1997). Irrigated area remained constant during the Israeli occupation and the rate of increase of the irrigated area between 1966 and 1994 was very low, only 1.6 percent. On the other hand, the irrigated area in Israel increased by 340,000 dunum from 1970-1990 (Al Musa, 1997).

Irrigated area in Palestine consumes 151 MCM of water, whereas in Israel it consumes 1,252 MCM. About 64.5% of the total irrigated areas in the West Bank is used for vegetables. While the Israelis use to irrigate, citrus, avocado, mango, grapes, apples, peaches, banana, dates, wheat, corn, cotton, peanuts, potato, vegetables, flowers and flower bulbs that consume huge quantities of water but the Israelis support the farmers to irrigate such crops.

There is a wide variation in water consumption for domestic purposes between Palestinian and Israelis, as the per capita water use is  $30 \text{ m}^3$  for domestic and industrial purposes for Palestinians in comparison to  $100 \text{ m}^3$  for Israelis for domestic purposes. During summer months, most Palestinian communities experience extended water shortages that last for weeks. For example, during the summer month of 1998, Israel supplied the Palestinian residents of Hebron district with  $8500 \text{ m}^3$  of water per day which is half the regular allotment of  $1700 \text{ m}^3$  of water promised to the city and nearby areas under the items of water agreements.



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The problem is exemplified by the table below showing average consumption of water in Israel and Palestine.

**Table 3** Water consumption in Palestinian territory and Israel

	<b>Palestinian</b>	<b>Israelis</b>
Total population	2,895,683	5,757,900
<b>Consumption, MCM</b>		
Domestic	87*	571
Industrial		136
Agriculture	151	1252
<b>Total consumption</b>	<b>238</b>	<b>1959</b>
<b>Consumption per capita, m<sup>3</sup></b>		
Irrigation	52	217.4
Domestic	30	99.2
<b>Total</b>	<b>82</b>	<b>340.2</b>
<b>Areas, dunum</b>		
Contribution of agriculture in GDP, (%)	15-20	1.8
Total irrigated area	201,359	2,177,500
Percentage of irrigated area to cultivated	11.1	61.95
Irrigated area per person	0.07	0.38

*\*For industrial and domestic purposes*

*Source: Statistical Abstract of Israel, 1998 for Israeli data  
 for Palestinian data: PWA, 1997 and Nassereddin, 1997.*

Israeli settlements receive continuous water supply, largely from wells in Palestine, and are provided service of greater quantity per capita than that received by Palestinians in the West Bank and Gaza. When the low monthly quota levels for Palestinian municipalities and towns are approached, the remaining supply is constricted, and communities may be without water for extended periods of time. Heavy fines are imposed by the Israeli Civil Administration for pumping beyond low quota levels.

### **Water Demand**

As discussed earlier, Palestine suffer form water shortage. Current demands, however, for agricultural water exceed supplies. In the future, if the present situation and military occupation continues, no increase of the water supply will be expected to take place, except for agriculture as there is a possibility of using small quantities of treated wastewater from Palestinian cities. The Palestinian water demands per capita are expected to reach those of Israelis by the year 2020 if the peace agreements are reached between the Palestinians and Israelis. It is predicted that by the year 2010 the total



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amount of water needed for domestic, agricultural, and industrial purposes will exceed the yearly replenished 650-730 MCM of fresh water in the Palestinian Territories (Table 4) (ARIJ, 1994). In addition to this, the Palestinian tourism sector adds further pressure onto the available water resources. It is estimated that each tourist uses 230 liters/day, compared with local consumption which is estimated at 50-90 liters/day in the Palestinian community (ARIJ survey, 1995). By the year 2000, it is expected that at least 7-8 million tourists will visit the Palestinian Territories to participate in the celebration of the 2,000th anniversary of the birth of Christ. This will put more pressure on the West Bank aquifers, and necessitate finding alternatives to groundwater. This will require a switch in approach from just increasing the supply to demand management, which focuses on the more efficient use of water.

**Table 4** Domestic, agricultural, and industrial water demand, in MCM, for the years 2000, 2010, and 2020.

Location	2000			2010			2020		
	Dom.	Agr.	Ind.	Dom.	Agr.	Ind.	Dom.	Agr.	Ind.
West Bank	174.2	146.3	13.0	317.8	234.3	26.7	508	345	43.5
Gaza Strip	88.5	70.2	5.2	166.1	70.2	10.7	278.8	70.2	17.4
<b>Total</b>	<b>262.7</b>	<b>216.5</b>	<b>18.2</b>	<b>483.9</b>	<b>304.5</b>	<b>37.4</b>	<b>786.8</b>	<b>415.2</b>	<b>60.9</b>
<b>Grand Total</b>	<b>497.4</b>			<b>825.8</b>			<b>1269.9</b>		

Source: ARIJ, 1994 (Note: Dom. = Domestic, Agr. = Agricultural, and Ind. = Industrial.)

### Water and the Oslo agreement

It is now almost five years since the initial peace conference at Madrid was inaugurated. Upon Israel's insistence, the peace process was divided into two tracks namely the bilateral negotiations and the multilateral talks. The bilaterals were intended to lead to peace treaties between Israel on the one hand and each of the regional parties, namely Jordan, Lebanon, Palestine and Syria on the other. The multilateral track was intended to complement and support the bilateral track by promoting regional cooperation. A special working group was established for water resources in the multilateral negotiations.

So far, a peace treaty has been reached between Israel and Jordan in which the water dispute between the two states was resolved based on mutual recognition of the "rightful allocations" of both parties to the Jordan and Yarmouk Rivers as well as the Araba ground waters. The Agreement allows for the use of Lake Tiberias for storing Jordanian surplus rain flows from the Yarmouk to be redrawn during the summer. It also maintained the right of Israeli farmers to draw water from the Nubian sandstone aquifers from the Jordanian territory in the Araba Valley. Israel and Jordan are now working on constructing two dams in the lower Jordan River Basin. There is no doubt that this



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bilateral agreement will not be a substitute for an integrated and comprehensive agreement among all riparians to the Jordan River basin.

On the Israeli-Palestinian track, water was one of the major sticking points in the negotiations leading to the signing of the interim Agreement (Oslo II) in Washington last September. Water is referred to under article 40 of Annex 3 “ Protocol concerning Civil Affairs”.The first principle in the article dealing with water and sewage states “.Israel recognizes the Palestinian water rights in the West Bank. These will be negotiated in the permanent status negotiations and settled in the Permanent Status Agreement relating to the various water resources.” There is no doubt that this may be considered as an important breakthrough as it is the first time that Israel has recognized the Palestinian water rights. While the Agreement did not go into the details of the Palestinian water rights, the use of the term “various water resources” in the second sentence is very significant.

While this recognition is a very important step forward, the second and third principles in the Agreement attempt to undermine the significance of this issue by talking about maintaining existing utilization and recognizing the necessity to develop new resources, tacitly accepting that more water is needed to satisfy the needs of both populations. The Agreement states that “all powers currently held by the civil administration and military government relating to water and sewage will be transferred to the Palestinians, except for those specified as issues for the "final status negotiations." Nevertheless, the Israeli authorities have not transferred the authority of the West Bank Water Department to the Palestinian Water Authority until now.

In Article 40 of the Oslo II agreement, it was agreed that the future needs of Palestinians in the West Bank are between 70-80 MCM/year of fresh water. It was also agreed that the immediate need of the Palestinians for domestic water use during the interim period is 28.6 MCM/year. The Palestinian responsibility is to supply 19.1 MCM/yr of water through the drilling of new wells, whereas the remaining 9.5 MCM/yr is to be supplied by Israel (Oslo II, 1995).

In order to honor the Palestinian commitment of providing 19.1 MCM/yr of newly supplied water resources, coordination was necessary within the framework of the joint Israeli-Palestinian-American Committee agreed upon by the Joint Water Committee (JWC) on water production and development-related projects. A project was initiated which was to begin execution in July 1997. Six monitoring wells, between 300 and 700 m in depth, and six pairs of water supply wells, between 350 and 850 m in depth, were to be constructed at locations in the Hebron, Bethlehem, Jenin, Nablus, and Ramallah areas. Within the framework of JWC, the Israelis had given the Palestinians proposed locations, but not permission, for 11 well sites for constructing Palestinian wells. These proposed wells were to be located in Hebron, Bethlehem, and East Jerusalem to tap the Eastern Aquifer System. According to the working plan of the project, the wells were to be completely constructed within 18 months of initiation. So far, only two permissions have been given to construct two wells in the Hebron-Bethlehem area in the Herodion well field. Moreover, and in violation of the agreement by the Israelis, Israel has only



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supplied an additional 7 MCM of water per year of the 80 million to which it has committed itself.

The new wells dug so far are:

- New well at Batn el Ghul-Well No. 5 in Bethlehem district (active since 1994)
- Bala'a well in Tulkarm district (active since 1995)
- E'in Sinya well near Jifna in Ramallah district was dug by the Jerusalem Water Undertaking (JWU) in cooperation with GTZ in 1994, but it has failed to produce water.
- Mekorot constructed a new well for the municipality of Jenin in 1996 in order to provide its population with an additional 1.4 MCM/yr as stated in the Oslo II Interim Agreement. The well has failed to extract water and negotiations are still going between the Israelis and Palestinians as to the causes of failure and the possibility of other alternatives for water supply there.
- Hebron Municipality, in cooperation with GTZ, is currently constructing two wells for domestic purposes in the wadi Sa'ir area which are expected to be in operation soon.
- A new well was constructed by Mekorot in February 1996 in accordance with Oslo II agreement for the interim period, however, it was considered by Israel as non-feasible and the well was shut down. Negotiations are still continuing between the Palestinian Water Authority (PWA) and Israel regarding this well.
- Another well was constructed by Jerusalem Water Undertaking in cooperation with GTZ in 1994 at E'in Sinya of Ramallah district but it was also failed to pump water.
- Another two wells are being currently constructed in Wadi Sa'ir area for the Hebron Municipality in cooperation with GTZ.

Regarding the overall additional 70-80 MCM/a, the bulk of this volume was to come from the eastern aquifer, where the main portion of the water not yet exploited was brackish. Harnessing such water requires relatively large initial outlays and can pose an environmental hazard because of potential brine leakage into the source aquifer. In sum, Palestinians are getting an additional 7 MCM of water per year of the 80 million to which Israel has committed itself. So far, the Palestinians in the West Bank and Gaza have not seen the translation of this Agreement to water in their taps, but are witnessing severe water shortages. The water issue has been a contentious one, involving a conflict with the United States because Israel refused to allow implementation of a provision of the Oslo peace accords to allow the Palestinians to drill three wells in the area of Herodion. The US allocated 46 million dollars for the project which was to be carried out by an American company. Six months ago, the ministry gave permission for two of the wells, but did not grant a permit for the third -- and largest -- well to be drilled near the Jewish settlement of Takoa. American experts say it makes no sense to drill for the two smaller wells if they cannot drill the third well because they need all three together to geologically determine sources.

Israel intends to hold large areas of the West Bank in order to create "security zones" and to make sure that Israelis water resources are not exposed to dangerous. Minister Sharon



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was quoted saying: “My view of Judea and Samaria is well known, the absolute necessity of protecting our water in this region is central to our security. It is a non-negotiable item”.(Boston Sunday Globe, Sunday, October 18, 1998). In one of his meetings with the Palestinian negotiators, the Israeli water commissioner Ben-Meir said : “I recognize needs , not rights.” We are prepared to connect Arab villages to Israel as well, but I want to retain sovereignty on hand”. Such statements confirm Palestinian fears of a dry peace and Israel’s genuine aspirations for peace.

### **Prerequisites for a sustainable water agreement between Israel and Palestine**

#### □ Distinction between Hydrology and Hydromythology

The water issue has been exploited by many Israeli politicians to serve their agendas. Water became a security issue implying that Israel is a water scarce country whose viability depends on retaining all the water resources it now controls. Security is perhaps the central concept in Israeli political dialogue - the slogan "national security" is frequently reformulated in terms of "environmental security", "food security", "water security". As de Shalis and Talis (1994) observe, the Israeli political agenda is overburdened with security issues: "Almost any political question in Israel is overridden by even the smallest security consideration". It is this obsession with security that informs many of Israel's approaches towards solving the water crisis. Above all, Israel has felt a need to have military or political control over its water supplies, and has therefore resisted perceiving the problem in terms of water rights, or in the economic terms of supply and demand, surplus and deficit.

While one questions the wisdom of needing to allocate 100 cm of water per capita per year for domestic purposes, even with such a figure, Israel and Palestine have between them enough fresh water resources to meet the needs of an overall population of 21.3 million persons. When both countries reach that stage in 30 – 40 years, water desalination or mining of fossil aquifers can be sought.

#### □ Abandon fantasies and quick fixes

Israel's proposed solutions to the water conflict have focused on “ enlarging the pie” by increasing the water supplies to the region. A wide array of proposals have been made ranging from multi-billion dollar Red-Dead or Med-Dean canals, peace pipelines from Turkey, Lebanon, or Egypt to Medusa Bags ferrying water from countries with water surplus to those in short supply, to tugging icebergs from northern areas, to mega-desalination projects. The recent Israeli proposal that has been submitted to donors is to built a mega-desalination plant in Gaza to provide 50 MCM per annum of desalinated water to solve the water crisis in Gaza. The estimated capital costs for such a plant are 250 million US dollars and the estimated cost for producing each CM of desalinated water is one dollar. This means that Gazans will be spending 5 % of their GNP to satisfy their domestic water needs. Certainly, it makes more sense to have such desalination



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plants in Israel, which has a larger Mediterranean shore and where the GNP is \$ 17000 and can afford such costs. Frankly, such dream-solutions flounder in the face of astronomical capital expenditure and environmental concerns.

□ Focusing on endogenous ways for enhancing supplies

Internal supply enhancement projects are economically, politically and environmentally more feasible than the much vaunted mega-projects. These could be easily developed in both Israel and Palestine. For instance, rooftop rainwater harvesting is currently utilised in 34 % of Palestinian houses, supplying at least 10 MCM of fresh water for domestic use. This explains how Palestinians are coping with the Israeli suppressed water supply. simple measure could potentially provide an additional 17-25 mcm per year in the West Bank alone. The collection of rainwater run-off from agricultural plastic sheeting in green houses could enhance water supplies by a further 4 mcm. Such practices would not lead to significant aquifer depletion: 75% of rainfall, it should be noted, is lost through evaporation.

Another important water resource is the treated waste water that could be used for irrigation. Sewage collection networks in the West Bank and Gaza Strip cover approximately 25% and 30% of the population. Most of the existing systems are old and poorly designed, with the exception of the one for Bethlehem and its neighboring towns and refugee camps. Collected sewage is either discharged into open areas and valleys, such as in Nablus, Bethlehem, and Hebron, or directed towards treatment plants, as the case of Ramallah, Jenin, Tulkarm, Gaza City, Rafah, and Jabalia. A large percentage of wastewater is still collected in cesspits and open channels. Vacuum tankers are used to empty the cesspits when they become full. These tankers are owned by either the municipalities or privately. The collected wastewater is disposed of at any available location, whether open areas, streets, or wadis. The few treatment plants that do exist are for the most part not functional. Over the past four years, the Palestinian National Authority has directed the core of donor towards waste water collection and treatment. Unfortunately, its efforts are being hampered by Israel's settlement policies. Most of the wastewater generated in the Israeli settlements is disposed of on Palestinian lands. Israel is stalling the process of licensing Palestinian waste water treatment plants insisting that Jewish settlements be included. A clear case is that of Salfit, where work on constructing waste water collection and treatment has been stalled unless the settlement of Ariel is linked. For Palestinians, they recognize the environmental damage caused by irresponsible waste water dumping, but they cannot accept that this issue be exploited to legitimize the settlement policy.

These internal supply enhancement practices should be complemented by an increased focus on conservation. According to Palestinian water authorities, as much as 50% of domestic water is lost owing to old, inefficient supply systems. During the Israeli occupation period, the so called civil administration invested very little in developing the Palestinian infrastructure. The Palestinian Water Authority is investing heavily in



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rehabilitating the water supply networks in Palestine as well as linking the 25 % of the remaining Palestinian communities with water networks. The artificial recharge of aquifers could help to counter overexploitation of groundwater resources. Additionally, cloud seeding, a process in which chemical condensation nuclei are introduced into cloud systems, could increase precipitation by 10-20% (Schiller 1993).

□ Mutual recognition

Israelis and Palestinians should deal with each other as peace partners and neighbors. The suppressed water supply need to be lifted. An important confidence building measure that Israel needs to initiate immediately is the approval to link the remaining 25 % of Palestinian villages with piped water and increase the fresh water supply to Gaza from its national water carrier. Even inside Israel, there is need to do some restructuring. It is unfortunate that the Arabs in Israel who comprise 20 % of the population receive less than 2 % of the water.

□ Accepting the need to live in harmony with nature

There needs to be a recognition that the Middle East is an arid and semi-arid region, and that water use should be appropriate to this natural fact. Cultivated land should not be extensively irrigated; and water should certainly not be subsidized.

□ *Joint responsibility for the protection of water resources*

Common water resources among both Palestinians and Israeli need protection. The Palestinians who are totally depend on these resources have to undertake such protection more than the Israeli. The contamination of groundwater resources has many reasons such as the population growth, urbanization and industrialization.

*Protection of Surface Water*

The only water accords that included water protection clauses are the Israel-Jordan agreements on water and environment. These agreements have identified numerous areas of cooperation in ecological protection. These included both Jordan and Yarmuk rivers. These agreements have stipulated two main issues the first one is the prohibition against dumping and industrial wastewater into the two rivers before they are treated and the second issue is the desalination of the saline springs that Israel diverted into Jordan River (1964, Annex II, Articles III.3 and 5). Such agreements could be served as a model for the future in the field of management and cooperation among the riparian.

*Protection of Groundwater*



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Protection of groundwater need a higher levels of cooperation between Palestinians and Israelis than that of the Jordan River surface water. That could be attributed for three reasons. First, the groundwater has to meet both the drinking and domestic standards, whereas the surface water has to meet the irrigation standards. Second, The extend of the aquifer under an extensive and active area exposed it to more contamination than in the river basin. Third, the rehabilitation and the cleaning-up of the damaged and polluted aquifers is more costly and time-consuming than that of the river basin.

In order to achieve the quality standards of water, and protect it from contamination, water quantity (extraction) as well as quality (sources of contamination) have to be monitored and regulated.

The regulation of water quantities could be achieved through an array of tools: legal, technical and economic. Both sides would deploy whichever tools would be effective within its own borders.

Regarding the protection of water quality, many factors must be taken in account, these include standards or limits on types and quantities of permissible pollutants. The standards can be applied to the water itself (ambient standards) or to the source of pollutants (source standards).

In the case of ambient standard, the permissible levels of contaminants would have to be apportioned between the Israelis and Palestinians.

On the other hand, source standards are too complex because of the numerous sources of the pollutants and the fluctuation of these sources over the time.

Regulatory measures for controlling the sources of contamination could be applied to the performance, technical aspects, or best management criteria of the source. Performance regulations may reflect the level of the wastewater treatment before the disposal. Technical regulations give a picture to how the source ought to be managed, operated, or maintained.

### **Towards a solution**

The water sector in the West Bank and Gaza Strip, is one of the most important strategic sectors which has remained undeveloped over the past three decades. The activities of the Palestinian Water Authority has been restricted by Israel to water supply administration, including operation and maintenance. Under these circumstances, the Palestinian water supply, both quantitatively and qualitatively, is in a particularly critical condition.

With the signing the Declaration of Principals (DOP) and the Oslo agreements, Israelis and Palestinians agreed on two main issues, the equitable utilization of water resources and joint management of these resources. They also agreed on the development of additional water for various uses (Taba Agreement, Article 40.2). Both sides identified the two issues as principles without defining them. Translating these principles into actual shares should be negotiated. The equitable utilization forms the basis for the



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allocation of the existing water resources and it is generally accepted by the International Water Law. However, the term equitable utilization cannot be easily quantified. In order to achieve equitable utilization of water resources, Palestinian water rights, recharge area, natural flow and population must be taken in consideration.

Palestinian water rights are summarize as following;

- Absolute sovereignty over all the Eastern Aquifer water resources, as this aquifer is entirely located beneath the West Bank and is not a shared water resource;
- Equitable water rights in the western and northeastern aquifers, as these aquifers are recharged almost entirely from the West Bank;
- Equitable water rights in the Jordan River System: as a downstream riparian nation to the Jordan River System, Palestine is legally entitled an equitable share of the system's water resources. In this context, the Johnston Plan for Middle East water allocation, which was developed in the mid-1950s, called for, among other things, a West Ghur canal to supply the West Bank with 120 MCM to meet the needs of Palestinians. While the plan of the West Ghur canal was never implemented solely because of the political conflict, the Palestinian water rights in the Jordan River System are and should remain.
- Water and fishing rights in the Lake Tiberias, this natural reservoir is an integral part of the Jordan River System, in which Palestine is a legally a riparian nation with the privilege to equitably utilize all of its available resources.
- Equitable rights in the Mediterranean Sea, Palestine is one of the coastal countries to the Mediterranean Sea and thus should enjoy full rights in its resources, including fishing and sailing, and should have the right to protect it from transboundary pollution.
- Full compensation for damages to Palestine's water resources caused by Israel and reimbursement for water that has been utilized by Israel for years.

On the other hand, the annual safe yield of the aquifers is apportioned according to the extent of recharge area. About 80% of the recharge area of the western basin is located within the West Bank while only three percent of the Jordan River's basin fall within Israel's pre-1967 boundaries. Eastern groundwater basin is an unshared groundwater basin as both recharge and storage areas are located within the boundaries of the West Bank

If it is accepted that allocation of water rights would be made according to equal per capita shares, the total quota of each side would be proportional to the population size. Thus, the 1940 MCM would give the Palestinians 650 MCM instead of 246 MCM which is currently used. The Israeli share should be 1290.8 MCM instead of 1960 which is currently consumed by the Israelis. The above distribution of water rights between the two sides is built on the population figures. The per capita consumption for both the Palestinians and Israelis will be  $224.2 \text{ m}^3/\text{a}$ .



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The resolution of the Palestinian-Israeli allocation and water rights disputes need to be will necessarily be governed by the principles of international law. Two legal aspects of the conflict concern us here. Firstly, Palestinians and Israelis must reach a consensus on sovereignty over water resources in the West Bank and Gaza. And secondly, Palestinians and Israelis must reach agreement on rightful allocation of shared water resources to each party.

Negotiations over allocations and water rights should be conducted with an eye on justice rather than might, and independent arbitration may be necessary. The international community and financial institutions should basked to make clear to all parties that loans for international waterway projects will not be forthcoming until the agreement is negotiated.

### **Water in the International law**

International law, it is often noted, is hindered by its ambiguity; nevertheless, it is only through such ambiguity that international law can fulfil its function of conflict resolution. Ambiguity is a necessary weakness of international law.

A further weakness of international law is that it can so easily be rendered impotent when a state ignores, or is not party to, the laws in question. The Geneva Convention, for instance, places restrictions on the powers of a belligerent occupier, and provides safeguards for the protection of the rights of those occupied. The Israeli government, however, claims that it is has not displaced a legitimate sovereign in either the West Bank or Gaza Strip, and hence is not bound by the Geneva Convention: this argument (which, it should be noted, even the Israeli Supreme Court has rejected) legitimates the alteration of legal and administrative structures, and the exploitation and degradation of resources, in the West Bank and Gaza Strip (Scobbie 1994). Such are the limitations of international law.

International water law is particularly limited. While the Helsinki Rules on the Uses of the Waters of International Rivers (1966), the Complementary Rules applicable to International Resources (1986) and the Seoul Rules on International Groundwater (1986) provide a framework for the resolution of riparian disputes, none of these Rules are binding in international law. The Rules are simply articles that have been adopted by the International Law Association.

Furthermore the Rules, by virtue of their necessary ambiguity, can often do little more than legitimate each riparian's claims. The Helsinki Rules, for instance, list a total of eleven relevant factors which should be considered in the resolution of a riparian dispute, a list which is not necessarily comprehensive. Article V (2) of the Helsinki Rules is worth



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quoting in full:

Relevant factors which are to be considered include, but are not limited to:

- (a) The geography of the basin, including in particular the extent of the drainage area in the territory of each basin State;
- (b) The hydrology of the basin, including in particular the contribution of water by each basin State;
- (c) The climate affecting the basin;
- (d) The past utilization of the waters of the basin, including in particular existing utilization;
- (e) The economic and social needs of each basin State;
- (f) The population dependent on the waters of the basin in each basin State;
- (g) The comparative costs of alternative means of satisfying the economic and social needs of each basin State;
- (h) The availability of other resources;
- (i) The avoidance of unnecessary waste in the utilization of waters of the basin;
- (j) The practicability of compensation to one or more of the co-basin States as a means of adjusting conflicts among uses; and
- (k) The degree to which the needs of a basin State may be satisfied, without causing substantial injury to a co-basin State.

Given this list of relevant factors, it is hardly surprising that each riparian is able to invoke principles which substantiate its perceptions of "legitimate national rights". Rights over particular water resources cannot be legitimately grounded in individual relevant factors, however. The relevant factors should be viewed as a totality, and the rights of parties in a riparian dispute should be interpreted, not absolutely, but relatively, in terms of the extent to which the relevant factors are applicable to the various parties.

Such an approach to water rights precludes the possibility of simplistic judgements about the 'ownership' of rights. Nevertheless, this approach does not prevent us from reaching the conclusion that Israel's control of regional water supplies contravenes the Helsinki Rules. This can be clearly demonstrated through a factor by factor analysis of Israel's claims.

Geography and hydrology (factors [a] and [b] above) provide a legitimate basis for Palestinians, not Israel, to claim sovereignty over West Bank waters. And as has already been mentioned, Israeli territory contributes only minimally to the Jordan basin, yet Israel utilizes the greater part of its waters.

Israel argues that current utilization of water must be considered, invoking factor [d]. According to Berck and Lipow (1993), "Prior use establishes water rights. Israel has



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honored prior use rights of Palestinians' allocated water before the Israeli conquest of the West Bank and Gaza but has appropriated all of the ground water that was still not being exploited in 1967". This argument is, to say the least, rather spurious. The claim is invalidated by the illegality of the occupation. And it is simply false to say that "Israel has honored prior use rights of Palestinians": the military authorities have expropriated wells belonging to absentee owners, as well as those within the boundaries of confiscated Palestinian land. The sometimes-invoked argument that Israel merely inherited water resources that had been under British Mandate control, meanwhile, is simply untrue. Palestinians, as the indigenous inhabitants of the region, are the party with historical prior use rights.

Israel is also keen to emphasize the economic and social damage it would suffer if its water allocation were reduced, a claim that invokes factor [e] above. The size of Israel's population (factor [f]) is often cited as a corollary to this point. The common implication is that the populations of Israel's co-riparians have only minimal economic and social needs. Meir Ben-Meir states most generously that "Israel will not irrigate cotton and let Palestinian children die from thirst" (quoted in Stutz 1994): implicit in this statement is the assumption that Palestinians only have personal, minimal water needs. On the contrary, Palestinians need water to build industry and agriculture, to build a modern Palestine that is worth building.

As for factor [f], Israel's 4.6 million population must be taken into account, but not to the exclusion of over 2 million Palestinians. The legitimacy of Israeli needs is further compromised by the fact that, of all the Jordan basin States, only Israel has an uneconomic water-guzzling agricultural sector that is not pivotal to the state's economy. Israel's focus on its needs does not stand up to international legitimacy.

The obvious conclusion is that Israel is flagrantly violating international water law. Unfortunately for Israel's co-riparians of the Jordan basin, questions of rights, justice and equity are being ignored. Instead Israel is pursuing its own agenda, centered purely upon a perception of its own "water security".



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