ETH Eidgenössische Technische Hochschule Zürich
Forschungsstelle für Sicherheitspolitik und Konfliktanalyse
Center for Security Studies and Conflict Research

SCHWEIZERISCHE FRIEDENSSTIFTUNG
FONDATION SUISSE POUR LA PAIX
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SWISS PEACE FOUNDATION

ENCOP

Environment and Conflicts Project

Occasional Paper No. 13, August 1995

Water Disputes in the Jordan Basin Region and their Role in the Resolution of the Arab-Israeli Conflict

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ISBN 3-905641-41-0

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Stephan Libiszewski

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0 Introduction

Since the mid-1980s, much has been written on the subject of imminent "Water Wars" in the Middle East (*e.g.* Bulloch & Darwish 1993; Starr 1991). Such statements, although drawing attention to an important problem, are exaggerated and misleading. It is true that the region remains one of the tensest areas of the world and the danger of war is not yet averted. But conflicts are still determined by deep political differences. However, hydrological matters undeniably represent an additional dimension to the Arab-Israeli conflict; a dimension the relative importance of which has been growing over recent years. Water resources in the Middle East are scarce by nature, and most of them are transboundary. Competition over the utilization of shared resources is therefore pre-programmed. Moreover, the catchment areas of water systems often coincide with disputed land. Israel, *e.g.*, receives more than half of its water resources from occupied Arab territories. Therefore territorial and hydropolitical interests are highly intertwined in the Arab-Israeli conflict. Water scarcity is increasing year by year due to persistent population growth, over-exploitation, and pollution of existing resources. A solution to the hydrological crisis is certainly not a sufficient condition for a lasting peace in the region, but it is nevertheless an indispensable one.

The present study deals with this context. It analyzes the water crisis in the subregion covered by the Jordan River Basin and its surrounding areas and examines the role water plays in the historical conflict between Arabs and Israelis. Special emphasis is given to the current Middle East peace process which started in Madrid in October 1991. The signing of the Declaration of Principles between Israel and the PLO in September 1993, the following Gaza-Jericho Agreement, and the Israeli-Jordanian Peace Treaty of October 1994 triggered a dynamic which makes a turnabout unlikely. The results achieved so far in the negotiations are analyzed in respect to their water-related stipulations and whether these arrangements might serve as a model for the resolution of the remaining hydrological disputes.

The study is part of a comprehensive "Geography of Environmental Conflict" which is under elaboration by the Environment and Conflicts Project (ENCOP). To assure its comparability with the other case studies of the program, the present one also follows the main lines of ENCOP’s analytical framework as presented in Occasional Paper no. 1. According to it the analysis of environmental conflict has to evolve along four steps: 1) describing the environmental situation in light of the human activities which lead up to it, in our case with particular consideration of the water crisis; 2) deducing the social and economic effects of environmental transformation and degradation; 3) analyzing the political implications of these socioeconomic effects and the conflicts arising from them; 4) evaluating approaches to peaceful conflict management and resolution on different levels of analysis (Libiszewski 1992; Böge 1992; Bächler 1993).

0.1 How to read this paper

This interdisciplinary approach implies a modular construction of the study. Although they are run through by a linear argumentation, the single sections are highly interrelated to each other. So, depending on the professional background of the reader and his or her knowledge of the matter, the study can be perused in different ways. The reader who wants to get a comprehensive picture of water scarcity and conflict in the Jordan Basin region will start with chapter 1, which outlines the eco-geographic setting and environmental problems of the area, and then continue along the given structure. Others might prefer to approach the subject by the socio-economic implications or directly by the political ones, and look back to the natural conditions of the region in a second run-through. Those who are already familiar with the topic will probably be particularly interested in chapters 5 and 6, and in the epilogue. These are the most current and original parts of the study dealing with the role of water in the current Middle East peace process, and placing the case study within the wider discussion on 'environmentally caused conflicts'. The rest of the paper might serve them as a reference work.

The author is thankful to all individuals and institutions who have inspired his work and helped to make it possible. Any comments and constructive criticism are welcome.

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1 The Environment of Conflict: Water Crisis in the Jordan Basin Region

1.1 General climatic and hydrological conditions of the Middle East

The Middle East lies in a transitional zone between equatorial and midlatitude climates. Because of general atmospheric circulation patterns, a characteristic of these latitudes is the prevalence of aridity. Scarcely any precipitation occurs during the summer months, average temperatures being at over 30° C and up to 50° in some zones. In winter the jet stream moves southward, reducing the temperatures somewhat and bringing small amounts of precipitation up to North Africa’s coasts. In all, annual precipitation remains low. In most areas of the Middle East rainfall lies under the agronomic aridity limit of 200 mm/year, and evaporation exceeds rainfall for most parts of the year.

In some areas aridity is tempered by westerly winds which move moist air masses from the Mediterranean and the Black Sea onto the land. These provoke orographic precipitations along the northwestern coast (the so-called Levant), which therefore has a Mediterranean climate, and on mountainous areas in the interior. The Taurus, Anti-Taurus, and Pontic Mountains in eastern Turkey benefit from these precipitations, as do the Elzburg and Zagros Mountains on the border between Iran and Iraq, the Jebel Alawi in Syria, the Lebanon and Anti-Lebanon Mountains in the country sharing their name, and the hills of the West Bank and northern Jordan. Here precipitations reach amounts large enough to ensure a positive water balance, or, to put it in other words, a 'water surplus'. These are the recharge areas of the region’s few fresh water supplies, which, depending on quantity, geomorphology and soil structure, collect in surface streams or percolate into underground aquifers (Kolars 1992: 103ff.).

1.2 Defining the Jordan Basin region and assessing its water resources: some methodological remarks

The Jordan Basin region is one of the zones in the Middle East that profits from these peculiar conditions. The Jordan River and its tributaries drain parts of the Anti-Lebanon massif and the Jebel Alawi in Syria. Some of the surrounding areas on the Mediterranean coast and on the hills in the interior possess a precipitation surplus which collects in groundwater layers. The region dealt with in this paper is defined as the catchment area of the Jordan River system itself and the areas adjacent to it. Areas outside the proper watershed of the Jordan Basin are taken into account especially if they include hydrological and other environmental resources of common concern to the parties involved in the Arab-Israeli conflict. Politically, the region treated includes Israel, the Kingdom of Jordan, the Occupied Palestinian Territories (West Bank and Gaza), and the South of Syria and Lebanon.

The first three parties mentioned cover about 80% of the drainage area of the Jordan River catchment system. They must be seen as the core part of the basin also in respect to the fact that they do not have other surface water sources, and only limited groundwater sources. Thus, they are particularly dependent on the resources in question. Syria and Lebanon are the possessors of important headwaters of the Jordan River system and therefore an integral part of the region as defined, and crucial political protagonists, too. But the main part of their territory, and their most important agricultural areas, are touched by other river systems, partly of far more importance. The bulk of Syria’s water demand is covered by the Euphrates, which crosses the country from north to east. Furthermore the country is crossed by the Orontes in the northwest. Lebanon, for its part, is a mountainous country and has several smaller internal rivers. Syria and Lebanon are taken into consideration in this study in respect to their involvement in the Jordan River’s watershed. But they are not considered as far as other water basins are concerned. For instance, the disputes which Syria has with Turkey and Iraq over the utilization of the Euphrates are not dealt with in this paper.

This leads us to a further methodological problem regarding the assessment of the water resources of a given region. Two approaches are possible in this respect. A country-by-country review tells much about each nation’s present water situation and probable future. But it tends to undervalue the transboundary nature of most water resources. It also creates problems in accounting when these resources are claimed by different parties. In official statistics, shared waters are often accounted for more than one time in the budget of each single country, distorting the real picture of the *regional* situation.

Therefore, in this study an eco-geographic rather than a nation-state approach has been chosen. The eco-geographic approach regards the catchment area of water basins, both surface and underground, as the unit to be examined. Figures on the water availability of each single state often already include patterns of distribution between the riparians of a shared basin. Country-by-country accounting will therefore be introduced in chapters 2 and 3, when socioeconomic and political implications of the water crisis are dealt with.

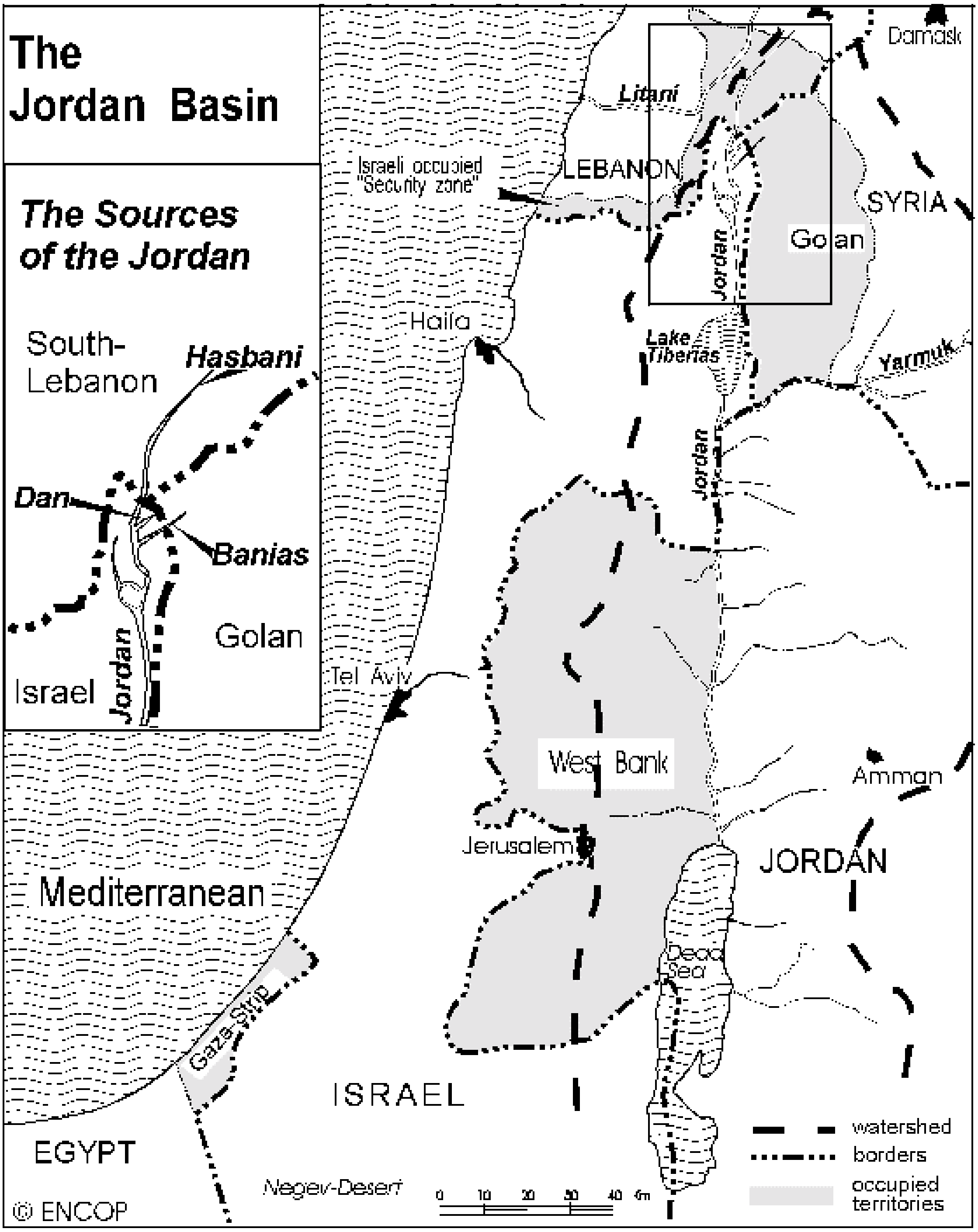
1.3 Surface water resources

1.3.1 The Jordan-Yarmouk River system

The most important single water source of the region is the Jordan River system. Its main axis rises on the western and southern slopes of Mount Hermon in the triangle between Lebanon, Syria, and Israel, and discharges into the Dead Sea, nearly 400 meters below sea level. It must be kept in mind that the real dimensions of this stream in no way match its biblical fame. Compared with other rivers of the world, the Jordan is a very tiny stream, rather a rivulet than a river in the proper sense of the word. All tributaries considered, the basin drains an area of only some 18,300 km^2. From its furthest source in Lebanon to the Dead Sea, the Jordan River measures about 230 km as the crow flies, and somewhat more if one takes into account all the meanderings it makes in its course. For comparison: the Rhine and the Rhone in Europe drain 145,000 and 96,000 km^2 respectively, while the drainage areas of the big river systems of the world like the Nile, the Mississippi, or the Amazon cover several millions of square kilometers (Gleick 1993b: 146).

Even more ephemeral are the water quantities in question. The total natural discharge of the basin - including all the tributaries - averages around 1,500 million cubic meters (mcm) (Kolars 1992: 110; U.S. Army Corps of Engineers 1991), with some authors giving even lower figures (Salameh 1992: 23; Beschorner 1992: 8). This is about 50 times less water than the Rhine’s, 65 times less than the Nile’s, and 400 times less than the Mississippi’s discharge (Gleick 1993b: 147). Furthermore, this already small amount is subject to extreme seasonal and annual variations. In February, for example, the river may carry as much as 40% of its total annual flow, but in each of the summer and autumn months, when water is most needed, it carries only 3-4% of its annual discharge (Lowi 1993: 28). In drought periods like 1987-91 the water discharge of the Jordan Basin can be reduced by up to 40% throughout the whole year (Kliot 1994: 178).

Map 1.1


The Jordan Basin
The Sources of the Jordan
South-Lebanon
Hasbani
Dan
Banias
Golan
Israel
Jordan
Litani
LEBANON
Israeli occupied "Security zone"
Damask
SYRIA
Golan
Jordan
Haifa
Lake Tiberias
Yarmuk
Jordan
Tel Aviv
West Bank
Amman
Jerusalem
JORDAN
Mediterranean
Dead Sea
Gaza Strip
ISRAEL
EGYPT
Negev-Desert
watershed
borders
occupied territories
© ENCOP

1.3.1.1 The geopolitics of the Jordan-Yarmouk system

These difficult natural conditions coincide with a no less complex political context concerning the national boundaries crossing the basin. The Upper Jordan, which forms the axis of the northern part of the system, is fed by three separate sources, the Dan, Hasbani, and Banias. The first of the three has the steadiest and largest flow (about 250 mcm per year on the average). The other two provide about half that amount each. Although the three headwaters lie very close to each other on the slopes of the same mountain, they belong to or are claimed by different countries: the Hasbani has its springs in Southern Lebanon, the Dan within Israel’s internationally recognized borders, and the Banias rises on the Golan Heights, which belonged to Syria until 1967 and are now under Israeli control. After converging on Israeli territory, the Upper Jordan flows through northern Israel and then empties into Lake Tiberias. This is the only natural reservoir of the basin and lies entirely within Israel’s pre-1967 borders. Here some 270 mcm of water are lost through evaporation, which also increases the salinity of the remaining water.

Ten km south of Lake Tiberias the Jordan is reached by the Yarmouk. This is its most important tributary which contributes 400-500 mcm of water to the basin. Despite its even shorter course, the Yarmouk’s geopolitics are no less complex than the Jordan River’s. Its main headwaters are situated in the Hauran Plain in Syria. Then the Yarmouk flows along the Syrian-Jordanian border (which in part follows the southern slopes of the Golan Heights presently controlled by Israel). Finally, before converging into the Jordan River, the Yarmouk flows through the Adassiya triangle. Here it touches Israeli territory for a few kilometers.

From this point on the Lower Jordan first forms the border between the Kingdom of Jordan and Israel and then between Jordan and the West Bank. The latter area belonged to the Kingdom until 1967 when it was occupied by Israel in the Six Days’ War. The West Bank is now under Israeli control and represents the main point of dispute with the Palestinians. Before reaching the Dead Sea the Lower Jordan further receives several little tributaries from both the east and the west bank of the valley, accounting for a few hundred mcm in toto. The most important of them is the Zarqa River on the Jordanian side, discharging about 95 mcm. Many of the others are just *wadis*, or seasonal streams, that carry water only after rainfall in winter (Murakami & Musiake 1994; Kolars 1992).

1.3.1.2 The utilization of the Jordan-Yarmouk waters

In analyzing human interventions on the Jordan River system it is important to keep in mind that the area of the basin in question is not just of very limited extent. It also covers only a small part of the countries concerned. Apart from Lebanon, which is well endowed with rainfall, the other riparians of the Jordan basin have wide areas with arid climate. Territory classified as arid covers 80-85% of Jordan, 60% of Israel, and 50-65% of Syria (Kliot 1994: 177). Therefore, efforts to exploit the Jordan and the

Yarmouk often tried to extend geographically the benefit of their waters by diverting them into areas outside the Jordan Valley proper.

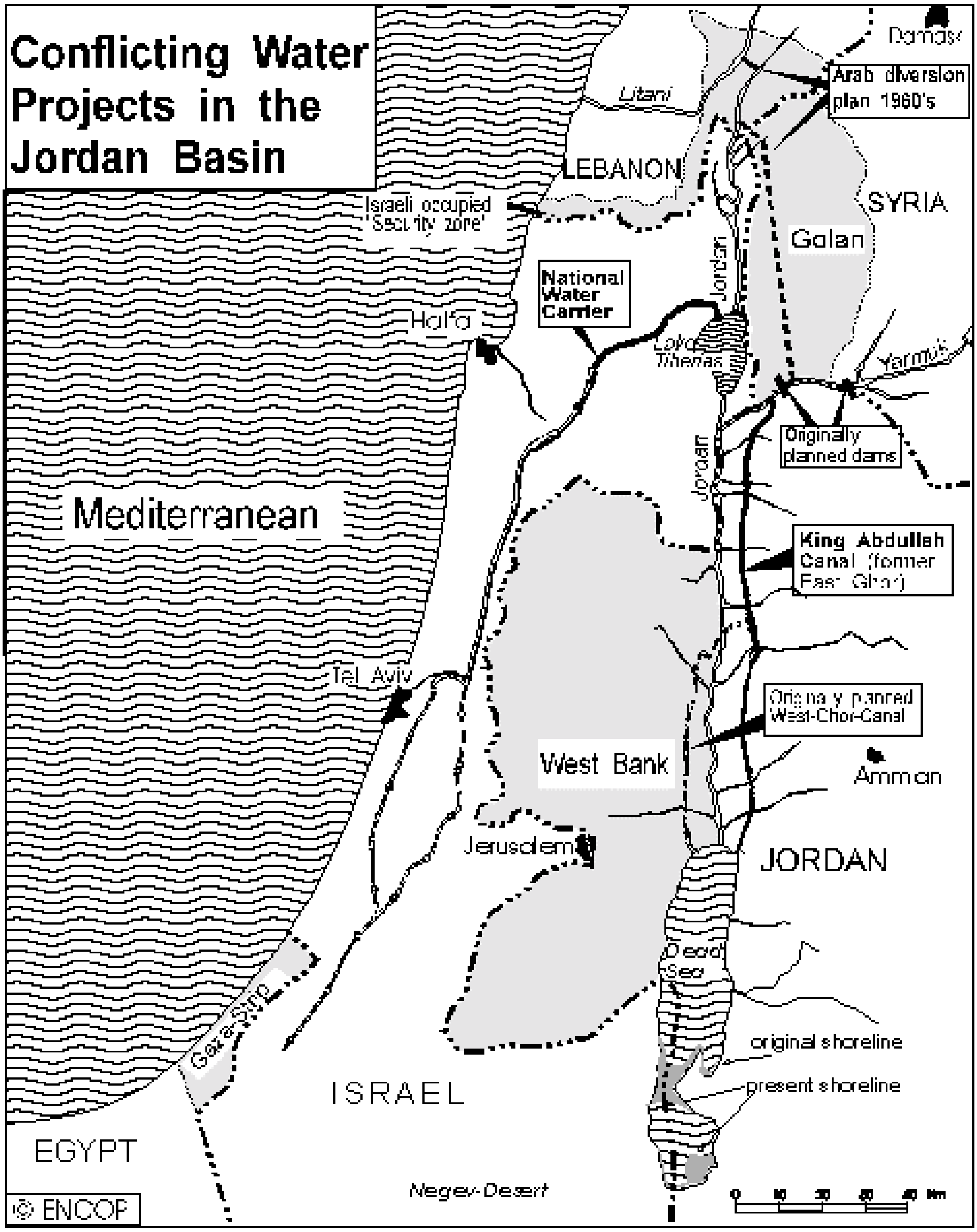
Plans to exploit the Jordan-Yarmouk waters date back to the turn of the century when the World Zionist Organisation began to assess the natural conditions of Palestine in view of the planned settlement of large numbers of Jewish immigrants (Wolf 1995: 15ff.; Gehriger 1994). But significant projects were realized only after achievement of independence by both Israel and its Arab neighbors in the late 1940s.

After the founding of the Jewish state in 1948/49, its principal concern was the development of the coastal plain. Israel’s first national water plan, made public in 1953, aimed at integrating "all the water resources of the country into a country-wide network which would collect water wherever it is available and distribute it to the areas where it is needed" (quoted from Lowi 1993: 49). The main component of the plan was the diversion of the Upper Jordan waters from Lake Tiberias into a central conduit leading through the coastal plain up to the northern Negev (See Map 1.2). Completed in 1964, this National Water Carrier can transport more than one mcm per day. Water conveyance by the conduit gradually increased from 195 mcm in 1965 to an average of 350 mcm per year in the 1970s. In the 1980s the carrier was conveying 420-450 mcm (Kliot 1994: 214). With direct water extractions in the Upper Jordan Valley and on the shores of Lake Tiberias (together about 100 mcm/year) this sums up to virtually the whole discharge of the river in its northern section.

The Kingdom of Jordan, on the other hand, was principally concerned with the increase of irrigated agriculture in the lower Jordan Valley. The keystone of Jordan’s efforts was the construction of the East Ghor Canal tapping the Yarmouk River, to irrigate land along the slopes on the eastern bank of the Jordan Valley. The project was designed by a team of Jordanian and American water engineers in 1959 and built with US, Western European, and Arab financial support. To date, the conduit, renamed the King Abdullah Canal in 1987, has been extended three times. It is now 110 km long and covers the entire length of the valley. In its course, the canal traverses and taps the Zarqa River, an unshared tributary of the Jordan, as well as several intervening seasonal streams (Lowi 1993: 155).

The original plans of the Jordanian project included construction of two dams on the Yarmouk. The first was planned at Mukheiba, near the intake of the King Abdullah Canal. The second dam was envisioned more upstream at Maqarin, on the Jordan-Syrian border. These dams should have allowed storing the winter flow of the river, increasing conveyance into the King Abdullah Canal - eventually making possible its enlargement to the western bank of the valley - and producing hydro-electric power. Although it was repeatedly revived, the plan to build storage reservoirs on the Yarmouk River could never be realized, mainly due to Israel’s political opposition and to financial problems (see also chapter 3.1). As a result, up to now Jordan was able to tap no more than 120-130 mcm of water on the average from the Yarmouk (Al-Mubarak Al-Weshah 1992: 127ff.).

Map 1.2


Conflicting Water Projects in the Jordan Basin
Litani
LEBANON
Arab diversion plan 1960's
SYRIA
Israeli occupied 'Security zone'
Golan
National Water Carrier
Haifa
Jordan
Lake Tiberias
Yarmuk
Originally planned dams
Mediterranean
King Abdullah Canal (former East Ghor)
Tel Aviv
Originally planned West-Ghor-Canal
West Bank
Amman
Jerusalem
JORDAN
Dead Sea
Gaza Strip
original shoreline
present shoreline
ISRAEL
EGYPT
Negev-Desert
© ENCOP
Km

The rest of the river's flow has increasingly been exploited by Israel and Syria. From the 1950s onwards, the former received 25 mcm during the summer months for irrigating the so-called Yarmouk Triangle between the southern shore of Lake Tiberias, the Jordan and the Yarmouk River. But in the 1970s, after Israel occupied the Golan Heights, these extractions began to increase. According to different sources, Israel pumped up to 100 mcm from the Yarmouk in the mid-1980s (U.S. Army Corps of Engineers 1991; Lowi 1993: 181; Brooks & Lonergan 1993). Since then, extractions seem to have decreased due to the drought in 1987-91. In the current Israeli-Jordanian peace negotiations, an amount of 70 mcm was assumed to have been the long-term average Israeli diversion quota over the last decades (Hof 1995: 48; see also chapter 5.2).

Towards the late 1960s and early 1970s Syria, in its turn, began to build numerous little dams and barrages on the tributaries of the Yarmouk. The goal was to increase the agricultural potential on that part of the Golan which remained under Syrian control after the Six Days' War. The country had to resettle about 150,000 people who had fled from the Golan Heights in the aftermath of the 1967 and 1973 wars, and was interested in creating a densely populated area opposite the Israeli-occupied zone (Kliot 1994: 209ff.). The quantity of Yarmouk water diverted by Syria is one of the most controversial figures in the whole discussion about water use in the Jordan-Yarmouk Basin. According to various sources reviewed by Kolars (1992: 110) these extractions lie between 90 and 250 mcm for the beginning of the 1990s. The real amount surely does not lie at the lower end of this range, because under the terms of the 1987 pact between Syria and Jordan on construction of a high dam on the Yarmouk (which was never realized) the Syrians were allocated 170 mcm. This was apparently the quantity they were diverting at the time (Kliot 1994: 212). In 1990/91, American mediators, trying to facilitate an agreement on building a dam on the river, concluded that Syrian depletion had exceeded 200 mcm annually and was growing further (Hof 1995: 51).

In sum, the utilization patterns of the Jordan and Yarmouk rivers must be characterized as a far-reaching *transformation* of the basin. The combined diversions by the riparians have changed the river in its lower course into little better than a sewage ditch. From the 1,300 mcm of water which used to discharge into the Dead Sea in the 1950s only a pittance remains at present. In normal years Israel allows a flow downstream from Lake Tiberias of just 60 mcm of water (about 10% of the natural discharge in this section), basically consisting of saline springs which previously used to feed the lake, and sewage water (Kliot 1994: 181). 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. The salinity of the Jordan River reaches up to 2,000 parts per million (ppm) in the lowest section, which cannot be afforded by any crop (Brooks & Lonergan 1993: 28). Only in flood years, occurring once or twice in a decade, is fresh water released into the lower Jordan Valley (see also chapter 1.6).

1.3.2 The Litani River

The second largest river of the region is the Litani River. This basin lies entirely within Lebanese territory. Thus, it is not to be considered a shared water body. Nevertheless, it is included in this study because parts of the lower reaches of the Litani lie in the so-called "South Lebanon Security Zone", which Israel has been occupying since its Lebanon campaign in 1982. The terms of Israeli withdrawal from this area represent the main bone of contention between Israel and Lebanon in the ongoing peace negotiations. Historically, the Litani has been the basis for territorial demands on the part of the World Zionist Organization and later an object of interest to Israeli governments. This has fed the fears of Lebanese representatives that Israel would use its physical presence in Southern Lebanon to divert the river (see therefore chapter 3.3).

The Litani rises in the Bekaa Valley near Baalbek and flows south down the axis of the valley between the Lebanon Mountains to the west and the Anti-Lebanon Mountains to the east. In its course the Litani approaches very closely one of the headwaters of the Jordan, the Hasbani (see Map 1.1). Near a place called Kaoukaba the distance between the two amounts to just a couple of kilometers. But then the river turns sharply to the west and flows to the Mediterranean through the Galilean Uplands. The estimated annual discharge of the Litani averages 700 mcm. A part of this water is presently extracted for irrigation purposes along the course. Another substantial part of the water is diverted to the Awali River through the Markaba Tunnel for hydroelectric power production. In sum, only 125 mcm of water are left in the lower course of the river, which crosses the Israeli-occupied "Security Zone" (Murakami & Musiake 1994: 128).

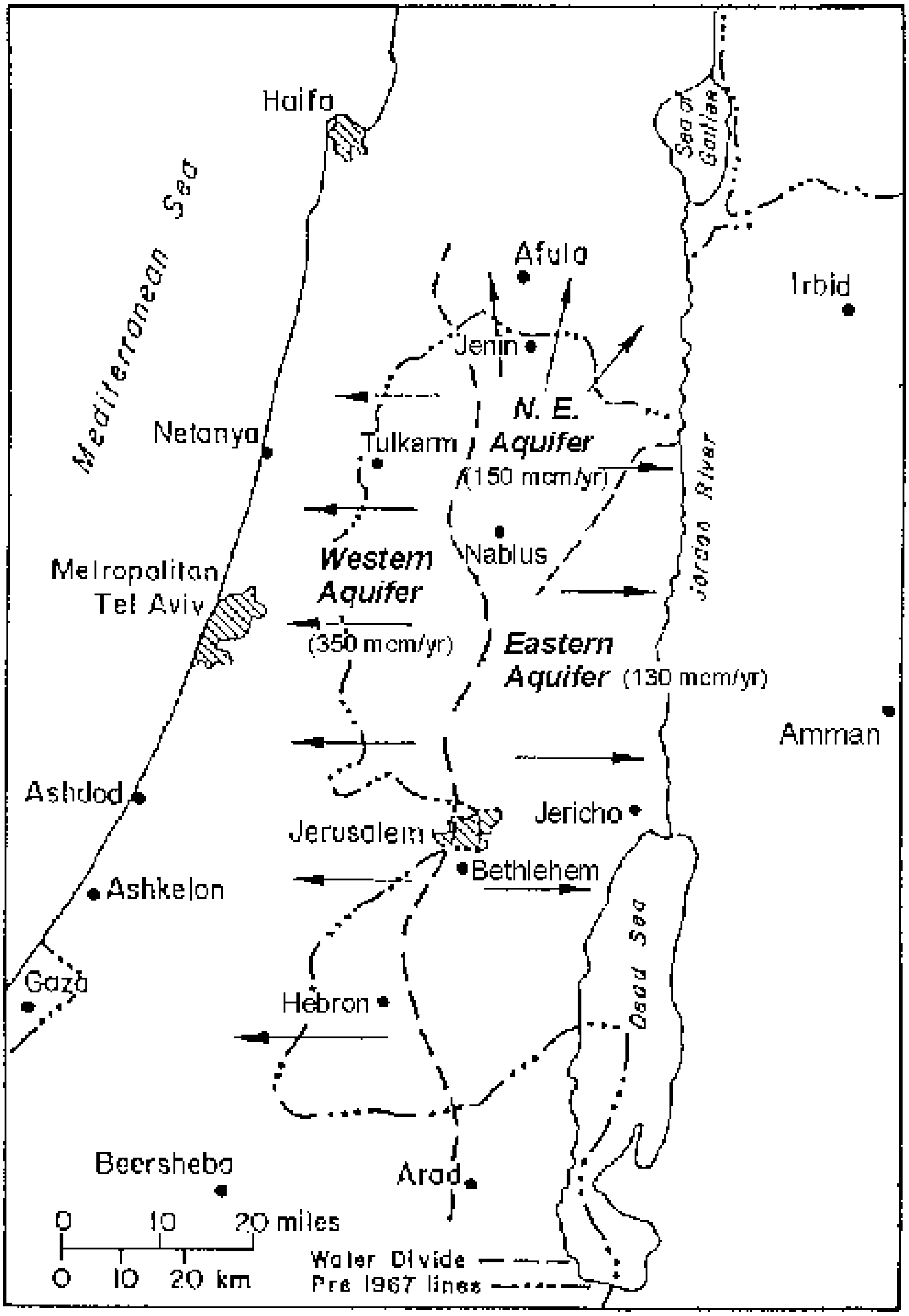
1.4 Groundwater Resources

1.4.1 The Mountain Aquifer of the West Bank

The aforementioned rivers and lakes are the most visible water resources of the region, but they do not cover the bulk of the water demand in Israel, Jordan, and the Occupied Palestinian Territories. In all of these three areas more than 50% of the available renewable supply is provided by groundwater. In the case of the Palestinians this source makes up nearly the totality of present consumption. The main groundwater basin of the region and also the most critical politically is the aquifer originating on the West Bank, also called the Mountain Aquifer. This groundwater layer covers the central area of the Occupied Palestinian Territories and a strip of adjacent Israeli territory. The aquifer consists mainly of karstic limestone/dolomite formations with recharge areas mostly along the upper mountain slopes and ridges at levels above 500 meters above sea level. Figures on the potential of the aquifer vary from 600 mcm per year to as much as 900 mcm; but the higher estimates seem to refer to the total water budget of the West Bank including surface runoff and eventually a share of the Jordan River. In the following, a safe yield of 632 mcm will be assumed, including the natural discharge of springs and

180 mcm of brackish water. This estimate is given by a joint team of Israeli and Palestinian water experts, representing a shared consensus on the matter (Assaf et al. 1993: 30).

Map 1.3
The Aquifer of the West Bank



Basing on: Assaf, Karen; al Khatib, Nader; Kally, Elisha; Shuval, Hillel: A Proposal for the Development of a Regional Water Master Plan. IPCRI: Jerusalem 1993.

The aquifer can be divided schematically into three general basins as shown in Map 1.3: 1) the Western Aquifer (called Yarkon-Taninim Aquifer in Israel), which is the most abundant, providing more than half of the total yield, i.e. 350 mcm, 40 of which are brackish; 2) the North-Eastern Aquifer contributing about 130 mcm (of which 70 mcm brackish); and 3) the Eastern Aquifer with about 150 mcm (of which 70 brackish). Only the last mentioned of the three lies entirely within the West Bank. The other two, including the most important Western Aquifer, must be qualified as transboundary, since they cross the 1949 United Nations Armistice Demarcation line, better known as the "Green Line". It is estimated that some 80-90% of the Western and nearly 100% of the Northeastern Aquifer are recharged by precipitations falling within the West Bank area. But the water then flows underground in a westerly direction towards the Mediterranean coast and in a northerly direction into the Bet She’an and Jezreel Valley. Both aquifers have natural outlets, namely the Yarkon and the Tanninim springs on the western slopes and the Ma’ayan Harod Springs in the north, which lie within Israel’s pre-1967 borders (Shuval 1993a: 47). The situation is somewhat comparable to that of a transboundary river, since the two aquifers have their replenishment area in a political entity other than their discharge. This creates the notorious upstream-downstream riparian dilemma (see also chapter 3.4).

Historically, use of the western aquifer by the local Palestinian population was limited to part of the flow of springs as well as some 20 mcm from traditional dug wells in the coastal area. Intensive exploitation of groundwater was initiated by Jewish settlers starting in the 1920s and 1930s. Prior to establishment of the state of Israel Jewish settlers already used a significant portion of the aquifer. The remaining potential was developed mainly by Israel in the period between 1948 and 1967, and by Israeli settlements on the West Bank after its occupation in the Six Days' War. A similar history and use pattern can be drawn up for the northeastern section of the Mountain aquifer (Shuval 1993a: 41ff.; Assaf et al. 1993: 26). The groundwater being mainly of good quality, this source is largely used for municipal supply. Because Israel’s coastal aquifer has deteriorated (see chapter 1.4.3), the Mountain Aquifer now constitutes the country’s main supplier of drinking water (State of Israel 1992: 57).

The Eastern Aquifer, which lies entirely within the West Bank territory, was used exclusively by Palestinian villagers and farmers until 1967. After 1967, Israeli authorities expanded their control over this section of the Mountain Aquifer and began to tap it, mainly to supply Israeli settlements implanted in the area (Shuval 1993a). Since the Jordan River is hardly useable in its lower section due to the high salinity of its waters (see chapter 1.3.1.2), the groundwater is the only fresh water supply for both Palestinian population and Israeli settlers living on the eastern part of the West Bank.

In sum, the use of the western and northeastern section of the aquifer reached the limit of safe yield already in the mid-1970s. Only the eastern basin seems to contain an unutilized portion of about 60 mcm of mainly brackish water, which would require treatment before use (Assaf et al. 1993: 20f.). Even so, in several parts of the Eastern

Aquifer wells have been over-pumped. For instance, in the Jordan Valley the water table has dropped by 16 meters since 1969. Over-pumping has also resulted in deterioration of water quality. In many places, nearby saline aquifers underlie the fresh water layers. Over-exploitation can thus lead to seepage of brackish water into the fresh water body. Detailed studies in the Jordan Valley have revealed a rise in total salt concentration by 130% and of chlorine by 50% in the period 1982-1991 (Awartani 1993: vi-vii; Jaradat 1993). Quality of water has also declined markedly in some parts of the western basin. In its national report on the Environment in Israel, prepared for the 1992 Earth Summit in Rio de Janeiro, the Ministry of Environment itself points out that "the potentially rapid rate of saline water infiltration to the aquifer (...) constitutes a real danger" (State of Israel 1992: 57).

1.4.2 The water crisis in the Gaza Strip

A particularly dramatic water situation is given in the Gaza Strip. As a result of a large influx of refugees in the aftermath of the 1948 and 1967 wars and of high birth rates, this very small area of 365 km^2 was inhabitated by more than 770,000 people according to Israeli sources and around 850,000 according to official Palestinian sources in 1994. Nearly 70% of them are registered as refugees (Israel Foreign Ministry 1994a; Palestinian Environmental Protection Authority 1994: 1). With more than 2,000 persons per km^2, the Gaza Strip is among the most densely populated areas of the world.

The hydrological situation is very critical as the Gaza Strip is not an area with conspicuous water resources. Rainfall occurs only in the winter months and averages between about 400 mm/year in the north and 200 mm/year in the southern part of the strip. Because it has no permanent rivers, the strip is wholly dependent upon rainfall on its surface and the immediately adjacent areas. These rains percolate into aquifers or concentrate seasonally into temporary flows (wadis).

The aquifer system underlying the Gaza Strip is an extension of Israel’s Coastal Aquifer and of the same sandstone type as the latter. At the First Israeli-Palestinian International Academic Conference on Water, held in Zurich in December 1992, experts from the two sides still disagreed on the question whether the two aquifers were a transboundary unit. Since the Coastal Aquifer is divided into several sub-aquifers this may be the case on a local level, but not overall.

A recent water balance prepared by the Palestinian Environmental Protection Authority reports a natural inflow into the Gaza Strip aquifer of about 50 mcm, consisting of 40 mcm of rainfall infiltration on the strip itself and 10 mcm inflow from adjacent areas beyond the border in the east (Palestinian Environmental Protection Authority 1994: 21). Other sources give somewhat higher figures mainly due to an assumed higher inflow from Israeli territory. According to data released by official Israeli sources to an investigation team of the European Community in 1992 the natural inflow into the Gaza aquifer consists of 47 mcm of rainfall infiltration and about 20 mcm of eastern groundwater inflow (The Commission of the European Communities 1993: 5). Yet, the

Palestinian side claims that this external inflow has been reduced due to pumping from wells adjacent to the border and damming of the Wadi Gaza in its upper catchment area lying in Israel (Tamimi 1991: 8; Palestinian Environmental Protection Authority 1994: 5). The aquifer is additionally fed by irrigation returns and sewage on the order of 20 mcm per year. As will be set out below, these infiltrations represent a serious danger for the aquifer's integrity.

Water consumption in the Gaza Strip now amounts to 100-110 mcm per year. Depending on the assumed natural inflow, this is some 50-100% above the natural replenishment rate. The over-exploitation has occurred for decades, starting during the period of Egyptian administration between 1948-1967 when practically no restrictions were imposed on drilling and pumping (Shawwa 1993: 26). After the occupation in 1967, the Israeli military government introduced strict measures, but these could only partially control over-pumping. In the meantime, the establishment of a number of Israeli settlements in the Strip, which are estimated to extract some four mcm from local sources, has additionally increased pressure on the groundwater table (Shuval 1993b: 98).

In the course of the years an enormous deficit has accumulated resulting in a continuous drop in the groundwater level throughout the strip. The general trend is about 15-20 cm per year. The result is that sea water seepage has extended some 1.5 km into the fresh water aquifer. Further to the east, a saline groundwater stratum partly even brinier than sea water underlies the Gaza shallow aquifer. Digging into this deeper layer has perforated the impermeable stratum dividing the two and led to mixing the brackish with fresh water (Shawwa 1993). The salinity of Gaza's groundwater typically increases at average rates of some 10-15 ppm chlorine annually. Moreover, growing nitrate and chemical concentrations from fertilizers, microbial contamination, and pollution by heavy metals and fuels from sewage effluents are aggravating the hydrological situation. More than 60% of households lack any well-controlled and -organized sewer networks. Waste water facilities are lacking or inoperational (The Commission of the European Communities 1993; see also chapter 2.3.2).

Since the PLO has assumed responsibility in parts of the Gaza Strip the situation even seems to have worsened. Delays in establishing an efficient water administration and resulting lack of monitoring, coupled with the harsh economic situation, led to uncontrolled drilling activity for agricultural and other uses. According to a Palestinian report, by the end of 1994 over 500 new shallow wells had been dug since September 13, 1993, the day the Oslo accords were signed (Center for Engineering and Planning Ramallah 1994: 16). This information corresponds with statements by Israeli inspectors that since Israel's pullout from the Strip the water quality in the area has deteriorated significantly (*Channel 7 Radio News*, 18 July 1995; as quoted by *Shomron News Service* No. 545, 18 July 1995).

1.4.3 Israel's Coastal Aquifer

Besides the Jordan River and the groundwater originating on the West Bank, the third main source of Israel's water supply is the Coastal Aquifer. This is composed of sand and sandstone formations along the Mediterranean shore and is replenished by rainfall on its surface. Its annual safe yield is estimated at 280 mcm, making about 15% of the country's total supply (State of Israel 1992: 51f.).

Overlaid by the most densely populated areas of the country and by a major portion of its industry and agricultural land, the Coastal Aquifer was among the first water sources to be exploited on a large scale. Consequently, it was also among the first which showed clear signs of exhaustion. In its natural state the water table is 3 to 5 meters above sea-level. Thanks to the force of gravity, this creates an outward pressure that blocks inflow of the very close sea water. During the 1970s and the 1980s, the aquifer has been overpumped to such a degree that the water table fell to less than one meter above sea-level, and even below sea-level in some areas. Salt-water intrusion is widespread and chloride concentration has increased from 100 ppm to 155 ppm on average in the last 20 years, exceeding that limit in many sites. If World Health Organization standards for drinking water were observed in Israel, many of the coastal wells would be unfit as sources of drinking water. Israel's Hydrological Service estimated that by 1992 one-fifth of the wells would have a salinity level above 250 ppm, making the water hardly suitable even for irrigation of such sensitive crops as citrus, avocado, vegetables and flowers (State of Israel 1992: 52; Schwarz 1994).

This situation improved somewhat after heavy rainfall in the winters of 1991/92 to 1994/95 and since Mekorot, the contractor of Israel's Water Authority, has been artificially recharging the depleted aquifer with water from the Jordan River via the National Water Carrier. But the extraordinarily high precipitations of the last seasons, which produced a surplus of fresh water allowing such measures, must be seen as temporary. In 1991 the cumulative deficit of the entire coastal aquifer was estimated by Israel's State Controller at 1.1 billion cubic meters, that is to say four times the annual replenishment (Israel Environmental Bulletin, Spring 1991). Dan Zaslavsky, Israel's Water Commissioner at the time, stated that 10 years of above average rainfall would be necessary to bring the water table back to normality. Worse yet, intruding briny water corroded the limy portions of the porous sandstones that make up the aquifer, so that they became blocked and are reduced in capacity or even destroyed. Therefore, parts of the aquifer are estimated to be damaged beyond repair (Brooks & Lonergan 1993: 62).

1.4.4 Internal groundwater resources in Jordan

In Jordan, 12 renewable groundwater basins are defined according to regional water divides, aquifer limits, or topographic features. They all lie entirely within Jordanian territory. However, it must be stated that they are all of very modest size, adding up to a total long-term renewable groundwater supply of about 275 mcm. This is due to the extreme small amounts of rainfall and the high evaporation rates prevailing in the country (Bilbeisi 1992: 10ff.).

Some fossil water can be added to these renewable resources. Fossil water is mainly found in the south of the country. Since these latter aquifers have been accumulated at greater depth during early geologic ages and have no recharge at present, their yield depends on the time horizon of exploitation. Studies have concluded that somewhat between 100-150 mcm can be exploited for a period of 50 years (Bilbeisi 1992: 12f.; Al-Fataftah & Abu-Taleb 1992: 159). These fossil aquifers are in part transboundary and thus must be shared with Saudi Arabia or Israel (see also chapter 4.1.3).

Groundwater resources are of particular importance for the country as 90% of municipal supplies are covered by them (Al-Fataftah & Abu-Taleb 1992: 162). During the last decade, due to population growth (both as a result of an over 3% birth rate and the influx of returnees from the Gulf), droughts, and impediments to developing other resources, the aquifers have been over-exploited at a higher and higher rate. According to official governmental sources use exceeded sustainable yield by 65% at the peak of the dry period in 1990, reaching 455 mcm compared to the long term yield of 275 mcm (The Kingdom of Jordan 1992: 5). On the average Jordan accumulated an annual deficit of about 75-100 mcm, which has been compensated for only in part by heavy rainfalls in recent winters.

Lowering of the water tables has allowed saline water to intrude from deeper aquifers or caused wells to dry out. The first experience with saltwater intrusion occurred already in the early 1970s when the salinity levels in the Jafer area in the south of the country escalated due to over-extraction of water. To this day, salinity levels are not low enough to render this basin completely usable again. In the Zarqa and Azraq areas, which are both used for irrigation and to supply Amman, water withdrawals began to exceed safe yields in the early 1980s. Water levels had been lowered by 3-5 meters by the early 1990s in the latter of the two basins, and salinity had increased to 700 ppm (Al-Fataftah & Abu-Taleb 1992: 162f.; also Friedrich Ebert Stiftung 1991).

1.5 Water pollution

The water crisis in the Jordan Basin region has been described mainly as a problem of quantities. However, a quality problem exists, too. As far as salinization of water resources is concerned, both problems are closely interconnected. Intrusion of saline sea or brackish water into the fresh water table and increasing salinity of some surface water bodies (like Lake Tiberias) are caused by quantitative over-exploitation of scarce resources.

But other sources of pollution endanger fresh water supplies of the region as well. The major non-point source of many pollutants is agricultural run-off, which includes sediment, phosphorus, nitrogen, and other chemicals. The warm climate and prominence of agriculture in the economies of the region help to make use of fertilizers and pesticides widespread. In Israel, legislation regarding use of agrochemicals is rather lax, resulting in a per hectare use of pesticides and fertilizer which rates among the highest in the world. Correspondingly high is the run-off flowing into streams or seeping into groundwater (Brooks & Lonergan 1993:63).

The situation is even worse in the Occupied Palestinian Territories where mechanisms of control and monitoring are all but non-existent and knowledge about proper use of chemicals among farmers is insufficient. "The result is the routine and heretofore virtually ignored contamination of Palestinian food, water and the environment posing a menace to farmers and consumers alike" (Hosh et al. 1992). Here again, the problem is most acute in the Gaza Strip but exists to a lesser extent on the West Bank as well.

Industrial and municipal sewage effluents are another source of pollution. Dumping is common in all countries of the region, often directly into water courses or into wadis which, at the next rainfall, allows contaminants to seep into underlying aquifers. A typical example is the Zarqa River in Jordan. It rises near Amman and receives effluents from industrial suburbs of the capital before entering the King Talal reservoir. It is intended to provide water to irrigate the lower Jordan Valley during the summer months. A treatment plant in Khirbet is supposed to decontaminate the water. But, misconceived and too small in size, the plant does not afford its purpose. Silt and other pollutants accumulate in the artificial lake. During the years of drought from 1988-1991 this led to a situation in which the authorities were forced to prohibit use of water from the reservoir (Lavergne 1993: 121).

In Israel, small streams in the highly populated and industrialized coastal area are the most seriously degraded. Few contain natural water, and some have dried up completely. Others carry sewage at various degrees of treatment, industrial effluents, and agricultural run-off. In recent years strong efforts have been made to improve wastewater treatment, both ameliorating the environmental situation in some areas, and providing additional quantities of treated water which can be reused for irrigation purposes. But a lot still remains to be done (see also chapters 4.1.4 and 4.1.5).

1.6 Drying out of the Dead Sea

A direct consequence of water diversion from the Jordan-Yarmouk-system by the three main riparians is the lowering of the Dead Sea’s water level. Two-thirds of the Dead Sea’s total inflow were traditionally supplied by the Jordan drainage system, the rest being accounted for by smaller rivers, saline springs, and the seasonal wadis draining directly into the lake. The Dead Sea being a terminal basin without any outlet to the oceans, this inflow used to compensate for the very high evaporation rate, maintaining a more or less stable water level of the briny lake during the past 10,000 years. This equilibrium guaranteed the survival of a unique landscape and ecosystem in the lowest place on the face of the earth.

Since realization of the large water diversion schemes in the 1960s the evaporation losses far exceed the remaining inflows into the sea. Currently, the Dead Sea is being lowered by about half a meter per year (except in particularly wet periods) (Steinhorn & Gat 1983: 84). From 395 meters below sea level in the early 1960s the level of the Dead Sea fell down to -407 meters in 1987, resulting in dramatic shoreline changes (Hosh et al. 1992). In 1976, when the water level reached -401.5 m, the Dead Sea fell into two parts, the sill of the strait between the El Lisan peninsula and the western shore becoming exposed. The southern part of the Dead Sea, which in contrast to the northern has a depth of only a few meters, dried up in the following years. This reduced the size of the lake by 25% (Gat & Stiller 1981: 1084). Evaporation ponds for potash extraction and tourist facilities in the southern part can be maintained only by refilling them artificially with water pumped from the northern basin.

Another consequence of reduced water inflow is the increasing salinity of the Dead Sea's water, particularly of the upper layer of the lake. For centuries the ecology of the Dead Sea was characterized by stratification of different layers of water differing in temperature and salinity. Fresh water flowing onto its surface from rivers and wadis mixed only to a slight extent with the much saltier lake water, tending to form less saline layers floating over a dense column of fossil water. As opposed to what its name would suggest, the Dead Sea was inhabited by several species of bacteria and one species of algae in this upper layer. But as a consequence of the inflow deficit the surface water became saltier and hence denser. By 1978-1979 the upper layers had actually become even saltier than the deep water. The water column of the Dead Sea turned over, the fossil brine mixing with the younger water, virtually sterilizing the lake. Since then, in particularly wet years, the water column has been stratified again, bringing back microorganic life to the lake for brief periods. But it could not reestablish the previous ecological equilibrium (Steinhorn & Gat 1983: 84 and 88ff.).

1.7 Other environmental problems of the region

Although water shortage is doubtless the environmental issue most likely to play a relevant role in the region's political conflicts, the Jordan Basin region is not spared from other ecological problems. Pollution of air, marine environments, and landscape, as well as soil degradation are on the agenda, too. Often they are directly or indirectly interrelated to the hydrological crisis. Like water scarcity, these environmental issues are the object of negotiations involving a separate multilateral working group within the frame of the ongoing Middle East peace process. They will therefore be treated briefly in this study, too.

1.7.1 Marine pollution

A growing population, urbanization, intensive agriculture, and an expanding industrial sector are also factors threatening the quality of the marine and coastal environment. From Alexandria on the Nile Delta to the Gulf of Alexandretta in Southern Turkey the

East Mediterranean coast is lined with population centers, tourist and port facilities, pipeline terminals and refineries, and factory complexes. Only a few towns on the coast possess sewage works, and industries often dump their waste directly into the sea. Furthermore, oil spills are the rule near ports and pipeline terminals. Coupled with stream conditions which do not favor a frequent exchange of the water, this makes the East Mediterranean one of the most polluted marine environments in the world (Berlan-Darqué & Kalaora 1993; State of Israel 1992: 66f.).

Another area of great concern is the Gulf of Aqaba, located at the northern end of the Red Sea. This semi-enclosed tiny strip of ocean, connected to the rest of the Red Sea by the only 5 km-wide Strait of Tiran, is the world's northernmost tropical sea ecosystem. The weak tidal currents result in a very calm surface, a constant temperature of the water between 21-26°C, and a high concentration of oxygen. This helps the Gulf support a unique population of more than 100 species of corals, nearly 1,000 species of fish, and hundreds of species of crustaceans and mollusks in a particularly fragile environmental equilibrium. For comparison: the Persian Gulf, which is more than 50 times larger, houses just some 300 species of fish (Sachs 1993). This unique landscape and the climate make the area very attractive to scientists, sport divers, and tourists from all over the world. This is the reason why many hotels and resorts have been developed there in the last years, attracting hundreds of thousands of visitors annually.

The Gulf has a significant strategic importance, too. Israel's few kilometers of shoreline around Eilat is the country's gateway to the Red Sea and Indian Ocean, while the port of Aqaba provides Jordan its only marine access. The port of Aqaba is also important for Syria and the West Bank and has served as a supply line to Iraq during the first Gulf War against Iran and later during and after the Iraq-Kuwait crisis. As a consequence, commercial activity at these ports has increased dramatically in recent years with development of oil terminals, mineral export facilities, naval bases, and marinas.

Industrial pollutants, municipal sewage, and unregulated tourist activity have already caused significant declines in coral life along key stretches of shoreline. In addition to degradation caused by ongoing activities, the specter of catastrophic destruction from a major oil or chemical spill looms large. Due to the small size of the Gulf of Aqaba and to its current conditions, a tanker accident here would suffocate the coral reefs and destroy a far greater proportion of the fish population than in the very much larger Persian Gulf. Until recently, strained political relations between the riparians of the Gulf of Aqaba (besides Israel and Jordan these include Egypt and Saudi Arabia) complicated international coordination and consequently increased the threat of an ecological disaster (Sandler et al. 1993). In the multilateral negotiations on the environment within the frame of the ongoing Middle East talks the Gulf of Aqaba was therefore singled out as a priority field for regional cooperation (see also chapter 5.4).

1.7.2 Air pollution and littering of the landscape

The Jordan Basin region faces further environmental problems which are typical of many parts of the world showing a rapid socio-economic and demographic growth. In regard to air pollution the main problem is the overall increasing consumption of fuel. In fact, the main sources of air pollution are energy production, transportation and industry. Since all countries of the region lack a fully developed railway system, diesel-powered buses and trucks account for a very high proportion of the vehicular fleet. Black soot emitted from diesel-powered vehicles is the reason for many public complaints and is also the cause of visible soiling of stone buildings and archeological sites. Obviously air pollution is most acute in the densely populated urban centers of Amman, Jerusalem, Tel Aviv, Haifa, and on Israel’s coastal area in general. The extremely high amount of solar radiation prevalent in this part of the world favors photochemical air pollution. A trend of increasing ozone concentration is indeed evident (State of Israel 1992: 73).

Another consequence of the change in consumption habits and of rapid population growth is the accumulation of increasing quantities of waste. A number of factors exacerbate this problem in the Middle East. The subtropical climate conditions contribute to rapid decomposition, unacceptable odors, and spontaneous combustion. Thus waste should be treated quickly and properly. With 1.5 kg of municipal waste per person produced daily, Israel reaches the high levels of affluent western societies. Some 98% of the country’s waste is disposed of in sanitary landfills covered with earth. But due to Israel’s small size, these often compete with other ecologically sensitive land uses like aquifers, nature reserves, archeological sites, and residential areas (State of Israel 1992: 92ff.). It also seems that not all toxic wastes produced by Israeli industries reach the official disposal sites. A survey carried out by a Danish company disclosed that in 1990 less than half of Israel’s industrial waste was disposed of according to regulation, and the Ministry of Environment seems to have no idea where the dangerous materials have gone. To save money, companies may have buried the waste on their own property, or dumped it elsewhere.

The situation is even far more acute in the Occupied Palestinian Territories. Since appropriate services are missing, municipalities merely dump garbage into a shared disposal area with no care taken as to treatment or burial. People living in rural areas tend to take rubbish to back road dump sites, where they leave everything from beverage bottles to car bodies. Such uncontrolled waste disposal sites are often scenes of further pollution. Rainwater washes contaminants into the groundwater, and spontaneous fires give off toxic smoke (Hosh et al. 1992). One of the most visible waste problems is the ubiquitous presence of discarded plastic, be it grocery bags or abandoned agricultural sheeting. Since plastic is transported by the wind and easily gets caught, fences and barbed wires throughout the territories are hung over with scraps of this unpleasant material.

1.7.3 Soil degradation

A further environmental problem typical for all arid and semi-arid regions is soil degradation and advance of the desert. Human influence upon the composition of the native vegetation cover has a long history in the Jordan Basin region. Old Testament references indicate that the cutting of forests began during antiquity. This practice has continued ever since for various reasons like gathering of wood for fuel and lumber, conversion of woodlands into arable land, and forest fires (both planned and accidental). Deforestation exposed the soils to erosion through climatic factors and to further human infringements like over-grazing. There is botanical-archeological evidence that over the past 5,000 years the region's climate has become gradually drier and warmer. It is highly probable that centuries of human activity, particularly the denuding of the vegetation cover and its interaction with the micro-climate, have intensified this process of desertification (Hosh et al. 1992).

Soil erosion and desertification have been stopped somewhat in Israel, where reforestation programs were started by the Jewish National Fund even before establishment of the state. By the end of 1991, according to Israel's Ministry of Environment, 190 million trees had been planted, spanning an area of 80,000 hectares or 4% of Israel's territory. This is in addition to 225,000 hectares of natural woodland, which is for the most part conserved in nature reserves and national parks. In the arid south of the country greening strategies have succeeded in stopping desertification and even pushing the edge of the Negev desert southward (State of Israel 1992: 44ff.). These strategies include the improvement and development of species which are adapted to the harsh climatic conditions and the planting of trees in reinforced natural water catchment basins. Also cattle, sheep, and goat grazing is regulated in Israel and confined to fenced areas. Therefore it does not pose a substantial danger. At present, most damages to Israel's green cover are caused by summer fires, which in one season can destroy the reforestation efforts of years. The most recent and largest fire in Israel's history was the fire in the woods of the Jerusalem corridor in summer 1995. It destroyed approximately two million trees over an area of 5,000 acres (*Israel Line*, 3 July 1995). Another problem, which is already evident in certain parts of the country, is an increase in soil salinity due to widespread use of brackish water for irrigation purposes (Brooks & Lonergan 1993: 63).

Fertile soils are far more endangered in the Occupied Palestinian Territories. The lack of regulations, together with the socio-economic consequences of military occupation, conspired to worsen the quality of soils in the last decades. Forestation was forbidden throughout most of the Occupied Territories by the Israeli authorities, and many existing trees were destroyed, either under security pretext or to allow the building of Jewish settlements. According to the Palestine Human Rights Information Center, between 1987 and 1992 more than 140,000 trees have been systematically uprooted and destroyed by the Israeli authorities (Aziz 1992: 21). Because of water shortage and competition from the subsidized Israeli agricultural sector, many Palestinian farmers, particularly in the eastern part of the West Bank, were forced to leave their land and join the labor market in Israel. Consequently, sizable areas of land were neglected and returned to semi-desert. On the other hand, confiscation and/or closure of large areas of land by Israeli authorities for settlement or military purposes has consistently reduced natural grazing areas of Palestinian and Bedouin cattleholders. Grazing areas constituted about 55% of the entire area of the West Bank and Gaza Strip in 1967. According to Palestinian sources this share has dropped to 15-20%. These remaining areas are being chronically overgrazed and are highly exposed to soil erosion (Hosh et al. 1992). (For comprehensive picture of environmental problems in Israel and the Occupied Palestinian Territories see also Isaac & Twite 1994b.)

1.8 Long-term prospects for changes in water balance

The basic cause of the water crisis in the Jordan Basin region is a rising imbalance between limited supply (basically constant) and rising consumption. In 1993-1994, about 12 million people lived in the area concerned. They had at their disposal around 3,000 mcm of renewable water resources yearly, resulting in a per capita availability of about 250 cubic meters on the average. Although unequal distribution of this amount among the parties will require differentiations in the next sections, this average is considerably below the 500 cubic meters which, as a rule of thumb, hydrologists indicate to be the limit of absolute water scarcity (see also chapter 2.2).

Rising consumption is a consequence of rapid population growth, due both to high birth rates and immigration (see chapters 2.2 and 4.2.7), marked expansion of the irrigated area in recent decades, and adoption of western lifestyles. The consequence is that the available resources are highly overexploited. The seriousness of the situation is highlighted by the fact that in Israel, the Occupied Palestinian Territories, and Jordan the ratio of water consumption to total supply is around or even above 100%. This means that literally every drop of available water is diverted from the natural cycle for human purposes, and even more water is utilized than the cycle provides. The over-use of existing resources not only reflects a current status of severe water scarcity. It also seriously endangers the stock of supply in the long term. A team of Israeli and Palestinian experts estimates that over the next 30 years some 100-300 mcm of drinking water will be lost through degradation of quality and destruction of aquifers in the area between the Mediterranean Sea and the Jordan River (Assaf et al. 1993: 38). This would mean, in absolute terms, a reduction of up to 15% of the available amount of natural water in Israel and the Occupied Palestinian Territories.

The current water crisis in the Jordan Basin region is a result of the over-use of available resources. In economic terms the crisis is therefore mainly a problem of *demand*, and in its spatial dimension, a *regional* challenge. Potentially magnifying the demand pressure on the water system is the specter of global climate change that could reduce the available *supply*. In general, there is great uncertainty about the regional impact of that global transformation. However, if it occurs, climate warming would affect the water supply situation in the Middle East in three ways: *firstly*, in the subtropics, to which the Middle East belongs, temperatures are likely to rise above the average. According to Lonergan & Kavanagh (1991), who surveyed a number of climate models, temperatures in the Jordan Basin region are forecast to rise between 15 and 30% above present levels. This would increase evaporation rates by 5 to 20%, exacerbating water losses from reservoirs, open conducts, and in agriculture, and augment demand for domestic and recreational consumption. *Secondly*, precipitations would probably decline (although the climate models are not consistent in their precipitation projections for the region). This would have obvious implications for the amount of water supplied to replenish streams and aquifers. *Thirdly*, the variability of precipitation might change, resulting in even more accentuated extremes between dry and wet periods.

A changing climate would furthermore pose great challenges to international agreements on water distribution which may be concluded among the riparians of international water bodies. Traditionally, such treaties stipulate water amounts or quotas to be allocated to the parties involved. This is done on the assumption that the climate will remain stationary - i.e. variable in the short term but unchanging over time. Indeed, hydrologists and lawyers have few tools with which they can incorporate future changes of uncertain magnitude. A decrease in flow could make achieved agreements obsolete and revive old conflicts (Gleick 1992: 14).

2 The Socio-Economic Impact of the Water Crisis

2.1 The importance of fresh water supplies

Climatic and geomorphologic conditions always had a far-reaching influence on human activities and politics in the Middle East. Historically, in most parts of the region permanent settlements were only possible along rivers which provided the water needed for irrigation. The challenge to make use of water resources other than rain falling on the spot seems to have played an important role in the emergence of culture and civilization. In his classical work on "Oriental Despotism", the German historian Karl Wittfogel (1957) formulates the thesis that the need to develop great infrastructures for irrigation has been the incentive for building bureaucratic organizations and first forms of centralist states in what he characterized as "hydraulic societies".

By applying technology and trade, modern states largely overcame this total dependence on their natural environment. But they still remain reliant on natural water, which is hardly a substitutable commodity. Prolonged lack of water will constrain the developmental chances of a society, affect its welfare, and thus endanger political stability within the single state and between it and its neighbors. In the words of Falkenmark and Lindth (1993: 80f.) "Easy access to water is not an end to itself, for any society, but a means to other ends: health, industrial and agricultural production, generation of foreign currency. (...) A regular intake of water is necessary for human metabolic processes, which are extremely vulnerable to disturbances in the water balance. (...) Adequate provision of water is also necessary for 'societal metabolism' by allowing essential socio-economic functions (...). Provision of safe water for households in villages and cities is thus a fundamental component of socioeconomic development, and of the social contract between the governed and the government."

For pure survival a human being needs between two and five liters of fresh water a day. Bedouin tribes afford to live with 20-30 liters including cooking and washing. For settled populations, 100 liters per person and day for domestic use are said to be the minimum requirement for safe hygienic conditions and a reasonable standard of life. Households in industrialized countries typically consume 250-350 liters per person in Europe and over 500 liters in North America.

But fresh water is much more than just a substance important to biological survival, hygiene, and individual well-being. It is also an indispensable raw material for nearly all economic activities. Worldwide, 92% of water resources are utilized outside private households, primarily in agriculture (World Resources Institute et al. 1992: 328). To grow an adequate diet for a human being requires about 300 metric tons of water yearly - nearly a ton a day (Clarke 1991: 3). Where this water does not fall naturally from the sky it must be provided to the fields by irrigation. Hence, 69% of global water consumption goes into irrigated agriculture. Great amounts of water are also needed in industry for washing, diluting, cooling, and preparing steam. Thus, the highly industrialized countries of the West typically utilize most of their water resources for industrial purposes. Water courses are furthermore a source of hydroelectric power and a means of transport. Through their fishery potential in some regions they are even an important direct deliverer of food. Last but not least, water bodies have a high recreational value. They are an important factor of quality of life and become economically significant for tourism.

As a rule of thumb, hydrologists designate those countries with annual supplies of 1,000-2,000 cubic meters per person as *water-stressed*. 1,000 cubic meters is typically considered the minimum per capita requirement of a moderately developed society. Countries with less than 500 cubic meters per capita suffer from *absolute scarcity* (Falkenmark & Lindth 1993: 82). This does not mean that these countries may literally have to suffer thirst. The amount of 500 cubic meters still means about 1,500 liters of water per person a day. But lack of water then requires application of expensive technologies and becomes a constraint on food production, social and economic development, and protection of natural systems.

2.2 Water balances in the countries of the Jordan Basin region in the light of expected demographic growth

Table 2.1 shows the fresh water availability in the Jordan Basin region at the beginning of the 1990s, and compares it to other selected countries in the Middle East and outside.

It must be noted that the figures give the *de facto* water availability for each party, thus reflecting not only natural conditions but also the distribution patterns of shared resources. Although with great asymmetries between them, the three core parties of the Jordan Basin region, including Israel, Jordan, and the Occupied Palestinian Territories, all lie under the absolute scarcity line of 500 cubic meters of water per person/year mentioned above.

Table 2.1
Fresh water availability in the Jordan Basin region in 1990 compared to selected other countries in the world

Country	***Yearly per capita fresh water availability*** *(in cubic meters)*	***Yearly population growth and expected population doubling*** *(at current rates)*
Palestine *(West Bank/Gaza)*	*100*	*3.2 % / (22 yr.)*
Jordan	*220*	*3.4 % / (19 yr.)*
Israel	*370*	*2.6 % / (27 yr.)*
Lebanon	*1,780*	*1.9 % / (34 yr.)*
Syria	*2,830*	*3.5 % / (18 yr.)*
Iraq	*5,285*	*3.1 % / (21 yr.)*
Egypt	*1,100*	*2.1 % / (31 yr.)*
Saudi Arabia	*160*	*3.3 % / (20 yr.)*
Qatar	*55*	*2.3 % / (24 yr.)*
India	*2,440*	*1.8 % / (35 yr.)*
Switzerland	*7,565*	*0.6 % / (116 yr.)*
USA	*9,951*	*1.0 % / (70 yr.)*

Figures on water availability consider only natural renewable resources. Note that in the case of upstream riparians of great rivers like Syria or Switzerland the national account includes water amounts which in reality are used or claimed by downstream riparians.
Sources: World Resources Institute (1992): World Resources 1992-93. New York, Oxford. Population projections according to UNDP (1994): Human Development Report 1994. New York, Oxford; own accounts.

Thus the area belongs to the zones with the lowest per capita fresh water supply in the world, second only to the desertic regions in the Sahara and on the Arabian Peninsula. But unlike the oil monarchies on the Persian Gulf and Libya, the parties in the Jordan Basin region possess neither own energy supplies to desalinate sea water at low costs nor greater reserves of fossil water to mine. They rely basically on the renewable resources supplied by the natural water cycle. Syria and Lebanon, for their part, show higher values. But it must be born in mind that Syria shares the bulk of its waters with Turkey and Iraq who both claim a part of the water listed in this table. Lebanon, on the other hand, owns the headwaters of the Orontes, which it shares with Syria.

The strained water situation in the Jordan Basin region becomes even more acute when one considers water demand and supply in the light of future demographic developments. The Middle East in general belongs to the areas with the highest population growth rates of the world, and the Jordan Basin region is no exception to that. Socioeconomic and cultural patterns, and in part the pro-natalist policy of governments, result in high fertility rates in most Arab countries. Jordan, Syria, and the Occupied Palestinian Territories all show growth rates of more than 3%, meaning a doubling of the population each 20-25 years or even sooner. In part - as has often been the case in Jordan - high natural growth has been exacerbated by refugee influx due to political events. In Israel, the lower natality as compared to its neighbors has repeatedly been made up by an active policy of immigration during the last decades. In the first half of the 1990s an immigration movement mainly of Jews from the former Soviet Union increased population by about 10% within a few years.

As in the past, population growth in the Jordan Basin region may increase even more in the near future due to extraordinary political developments. A Palestinian state on the West Bank and Gaza Strip could draw back hundreds of thousands of Palestinian refugees which have been living for decades in camps in the neighboring countries. Israel’s population is expected to double and that of the Occupied Palestinian Territories to rise by 150% within the next 30 years, if one realistically assumes that there will be immigration into this area in addition to a slowly decreasing but still high fertility rate (Assaf et al. 1993: 39ff.). Jordan’s population is projected to increase from 3.7 million in 1992 to 6.8 million in 2010 (Salameh & Bannayan 1993: 105f.). Although there are uncertainties about these demographic projections and population growth is not the only factor influencing water demand, the foreseeable increase will undoubtedly and substantially augment pressure on the region's natural resources. (See also chapter 4.2.7).

2.3 The social impact of the water crisis

2.3.1 Insufficient fulfillment of basic human needs

Table 2.2 shows that the greatest water consumer in the Jordan Basin region is agriculture (see also chapter 2.4.1). Nevertheless, the most direct consequences of the lack of water on human life and well-being will be those affecting domestic use. Although demand of private households will by nature be the last sector to be curtailed in a scarcity situation, the water crisis in the Jordan Basin region has had a marked impact on the living conditions of people in their homes.

Table 2.2
Water consumption by sector

	Population *(in millions)*	**Total water consumption**	**Agricultural** *(in %)*	**Industrial** *(in %*	**Domestic** *(in %)*
Israel *(1993)*	*5.1*	*1,754 mcm*	*63*	*6*	*31*
Jordan *(1992)*	*4.3*	*875 mcm*	*74*	*5*	*21*
Palestine *(1990 est.) (West Bank/Gaza)*	*1.8*	*210 mcm*	*62*	*38**	
Lebanon *(1990 est.)*	*3.3*	*1,060 mcm*	*74*	*7*	*19*
Syria *(1990 est.)*	*12.5*	*9,500 mcm*	*79*	*5*	*16*

* In the figures for the West Bank and Gaza Strip domestic and industrial consumption is accounted together. Note that Palestinian water resources, especially in the Gaza Strip, are highly over-used.
Sources: Statistical Abstract of Israel 1994; Salameh, Elias; Bannayan, Helen (1993): Water Resources of Jordan. Present Status and Future Potentials. Amman; Salameh, Elias (1992): Wasserressourcen der Arabischen Länder. Merkmale, Möglichkeiten und Zukunftsaussichten. Deutscher Naturschutzring (DNR)/ Bund für Umwelt und Naturschutz (BUND), Bonn.

Table 2.3
Daily domestic water consumption per capita in the Jordan Basin region (in liters)

Israel	*275*
Jordan	*115 (85)**
Palestine *(West Bank & Gaza)*	*63-104 (50)**
Lebanon	*150*
Syria	*130*

* The figures in brackets refer to the amount which really reaches the households, after other municipal uses and losses in the network having been subtracted.
Sources: Central Bureau of Statistics (1992): Statistical Abstract of Israel 1992, Jerusalem; Salameh, Elias; Bannayan, Helen (1993): Water Resources of Jordan. Present Status and Future Potentials. Amman; Elmusa, Sharif S. (1993): Dividing the Common Palestinian-Israeli Waters. An International Water Law Approach. In: Journal of Palestine Studies, Vol. 22, No. 3.

However, one must differentiate between the parties concerned. Most apparent is the discrepancy between Israel and its Arab neighbors. An average Israeli has at his private disposal an average of about 275 liters a day, a standard which is comparable to that of European countries. Water rationing to private households is very rare, even during drought periods. The same and even higher standards are typical in Jewish settlements on the West Bank and in the Gaza Strip (see also chapter 3.4.1). On the other hand, domestic water consumption is much lower and rationing is the order of the day in Arab states and among Palestinians in the Occupied Territories. This is in part a result of lower levels of socio-economic development and more adapted habits. But mainly it is due to constraints imposed by water scarcity situation and by unequal distribution of shared resources.

In Jordan, according to Salameh & Bannayan (1993: 105), water supplied for domestic uses was 180 mcm in 1992, serving a population of 4.3 million people. This results in a per capita consumption of about 115 liters a day. But the same authors argue that Jordan's inhabitants consume an average of only 85 liters a day in the households, the difference being explained by the high losses in the conduits and by other municipal uses. This means Jordan is the country with the lowest domestic water consumption in the Arab world. Syria, Iraq, and Egypt typically have a domestic consumption around 130 liters per capita. Lebanon lies around 150 liters. In Jordan, municipal demand has surpassed the available supply since the mid-1980s and rationing had to be introduced systematically in most provinces in 1988 (Bilbeisi 1992: 15). Especially during summer, 85% of the Jordanians live at the hygienic brink. Even in the capital, Amman, running water is only available then for a few hours of the week.

Figures on Palestinian domestic consumption in the Occupied Territories vary considerably depending estimates and assumptions on the population size of the territories, and whether or not East Jerusalem is considered in the calculations. Data summarized by Elmusa (1993: 65) result in a range between 68-96 liters for the West Bank and 63-104 for the Gaza Strip, including industrial and commercial consumption. But a more recent study carried out under the auspices of the World Bank concludes that effective daily water availability in the Occupied Territories is only 50 liters per capita if one subtracts industrial consumption and takes into account water losses in the municipal networks (Center for Engineering and Planning Ramallah 1994: 16; see also chapter 4.2.1). Furthermore, as average values, these figures do not consider seasonal and annual fluctuations, sub-regional disparities, and water quality indicators. In many Palestinian towns, water is normally cut off for considerable periods in summer. In the Bethlehem area, for instance, running water was missing for four months in 1994, forcing people to resort to highly overpriced water from tank trucks. On the West Bank, 26% of households are still not connected to piped water at all (Center for Engineering and Planning Ramallah 1994: 19).

2.3.2 Negative effects on human health

In both Jordan and the Occupied Palestinian Territories the hydrological situation is below supportable standards, and in many places it is imperiling public health. Apart from the quantity crisis, both areas are affected by quality problems as well. While in Jordan and the West Bank this causes widespread nuisances and occasional diseases, the crisis in the Gaza Strip is generalized.

Gaza's water resources have been chronically over-exploited for decades, resulting in a constant drop in the groundwater level and intrusion of briny water from the sea and nearby brackish water (see chapter 1.4.2). Shawwa (1993: 29) states that in 1992 60% of the water supply had reached a salinity of over 400 ppm, rendering it hardly usable.

The problem's order of magnitude is confirmed by other authors who in part draw an even worse picture (Hosh et al. 1992; Bruins & Tuinhof 1991 as quoted in Zarour et al. 1993). Earlier measurements dating back to the late 1980s showed that at the time only 22.5% of the groundwaters analyzed had a chloride content of less than 250 ppm, which is the World Health Organization's guideline limit for drinking water (The Commission of the European Communities 1993: 4). Moreover, the Gaza aquifer is highly polluted by irrigation return flows due to improper agricultural practices and the high porosity of the soils. The nitrate content reached an average of 116 mg per liter in Gaza city, with some wells reaching 280 mg, while the WHO limit is 50 mg (Ahiram & Siniora 1994: 26ff.).

Figures can only give an abstract picture of the discomfort to which Gazans are exposed in their everyday life due to hydrological crisis. The salinity of drinking water is clearly noticeable, since it leaves an unpleasant aftertaste which makes it hard to drink for Westerners. (Note that in Switzerland and in the European Union the quality target for chloride content in drinking water lies 10 times lower than the WHO's recommendation.) But unfortunately the poor water quality is not just a matter of taste; it has serious effects on human health. The continued consumption of water with a high mineral content is likely to increase dysentery, kidney, and cardiovascular diseases, as well as development of gynecological and pregnancy-related pathology (Bellissari 1994).

Moreover, the water supply in the Gaza Strip is seriously endangered by bacterial contamination, which is due to the lack of an adequate sewerage infrastructure. As the sanitary system in Gaza consists predominantly of cesspits, sewage disposal is both a source of water pollution and a major health problem. The situation is at its worst in the crowded refugee camps where about 40% of Gaza's population lives, but it is defective in most of the municipalities, too. Sewage is often discharged into open pools which are located just outside the camps. Water from these pools and pits easily percolates into the ground and reaches the aquifers. Because of bacterial contamination, the water supply to the households must be chlorinated to such an extent that, in its turn, chlorine concentration exceeds the internationally recommended limits. Despite that, in the Gaza Strip the number of infectious diseases due to contaminated water is twice as high as in the rest of the Occupied Palestinian Territories (United Nations, Economic and Social Council,Commission on Human Rights 1994 as quoted by Hottinger 1992: 162, ft. 3).

In November 1994, cases of cholera were reported from the Strip. They were clearly related to contamination of water and food (*Israel Line,* 9 November 1994). In fact, due to the general lack of water, untreated wastewater is often used to irrigate vegetable gardens (Ahiram & Siniora 1994: 263). The possibility of health hazards is thus a direct consequence of the shortage of groundwater needed for irrigation.

2.4 The economic impact of the water crisis

2.4.1 Constraints to agricultural production

Fresh water is no less an irreplaceable economic resource than a basic human need. First of all, in semi-arid and arid countries water is a requirement for agricultural production. Rainfed cultivation is possible only in the moister northern and coastal zones of the Jordan Basin region for field crops, or certain tree plantations like olives and nuts. All parts of the region require irrigation in summer for shallow rooted crops such as vegetables, and more water-intensive trees like citrus or avocados. In the dryer south-eastern part and in the lower Jordan rift valley, irrigation is necessary all year round for all crops.

To get an idea of agricultural water demands in arid and semi-arid areas, one should keep in mind that 10,000 cubic meters of water to one hectare per year is a fairly typical irrigation rate (Postel 1993b: 58). However, water requirements per hectare vary considerably depending on crops, irrigation methods, soil structure, and microclimatic conditions. Where modern irrigation techniques are used, these rates can be reduced by up to about half that amount. On the other hand, in arid areas and for water-intensive crops the irrigation requirements might be twice that and more. In Israel, *e.g.*, the average irrigation duty was about 6,000 cubic meters per hectare in the mid-1980s, compared with 17,000 cubic meters per hectare in Egypt and some 11,000 cubic meters per hectare in Jordan (Kliot 1994: 241). Translated into product output, these figures mean that growing a kilogram of tomatoes on the Jordanian side of the Jordan Valley requires 118 liters of water. Under the same conditions citrus fruits, bananas, and wheat need 418, 1,383 and 2,352 liters of water per kilogram of output, respectively (Schiffler 1993: 34 based on data by PRIDE 1992). Agricultural water requirements can be lowered by technology, but only to a certain degree. In Israel, the pioneer in developing water-saving irrigation methods, irrigation rates still reach 0.6 cubic meters or 600 liters per square meter of land (Kliot 1994: 241).

Table 2.4 shows some further basic indicators related to agriculture and water. Although all parties to the Jordan Basin region are restricted in their agricultural opportunities, the points of departure differ. Syria is the only country with large expanses of arable land, going into the tens of thousands of square kilometers. It must be pointed out, though, that the bulk of these areas is situated in the Euphrates valley and on the Mediterranean coast in the northwest of the country, *i.e.* outside the Jordan basin region proper. Lebanon, Israel, Jordan, and the Occupied Palestinian Territories, on the other hand, have to content themselves with very tiny areas of fertile land, in part accounting for a small share of their national territory (see especially the case of Jordan).

Table 2.4
Socio-economic and natural resources balance indicators

	Israel**	**Jordan**	**Palestine** *W.Bank/Gaza*	**Syria**	**Lebanon**
Population 1992 *(millions)*	5.1	4.3	2	13.3	2.9
GNP p.c. 1991 *(in US$)*	12,110	1,060	1,715	1,170	n.d.
Land Surface *(in km^2)*	20,500	89,000	5,640/ 380 *	185,000	10,500
Arable Land *(in km^2)*	4,330	3,720	1,520/ 170 *	55,640	3,010
in % of total surface area	21 %	4 %	27/ 45 %*	30 %	29 %
Irrigated Land *in % of total cropland*	50 %	15 %	6/ 58 %*	12 %	29 %
Irrigation water *(in cu. meters per capita)*	220	150	80	600	236

* The first data refer to the West Bank, the second to the Gaza Strip; ** East Jerusalem is included in the figures for Israel, although its status remains to be determined.
Sources: UNDP: Human Development Report 1994; The World Bank (1992): World Development Report 1992; The World Bank (1993): Developing the Occupied Territories. An Investment in Peace. Report No. 11958 Washington, DC; Awartani, Hisham: Palestinian-Israeli Economic Relations: Is Cooperation Possible. In: Fischer, Stanley; Rodrik, Dani; Tuma, Elias (1993): The Economics of Middle East Peace: Views from the Region. Cambridge/MA, pp. 281-304.

The situation is quite different when it comes to the second crucial agricultural resource: water. Israel and Lebanon are able to irrigate half and nearly 30% of their cultivated area respectively, while the others remain far behind. (The high share of irrigated land in the Gaza Strip is not representative, since total agricultural surface of the Strip is very small.) This is not really surprising in the case of Lebanon, which is well endowed with rainfall and possesses several smaller rivers. It is more surprising in the case of Israel, which is neither a water surplus country nor blessed by rivers (except the Jordan in the north and at its eastern border). Israel’s high irrigation rate is in part due to the very water-efficient technologies used by Israeli farmers. Yet not only efficiency but also the water quantities used are responsible for this high irrigation rate. Both the absolute water consumption for agricultural purposes and the per capita consumption are markedly higher in Israel than in Jordan and the Occupied Palestinian Territories. The gap between the parties concerned is highlighted by the fact that Israel has been able to irrigate 95% of its potentially irrigable land, while the irrigated Palestinian area on the West Bank is only one-third to one-fifth of what would be easily irrigable (Elmusa 1993: 64). The area irrigated by Palestinian on the West Bank has practically not been expanded since 1967 due to restrictions on land and water use (see also chapter 3.4.1), while it continued to rise in Israel.

Socio-politically, the most important indicator for lack of water is the level of food imports and food dependency. Throughout the region, food production has increased considerably during recent decades, but it has not kept pace with population growth. The per capita food production index rose only in Lebanon, the sole country which still has a water surplus. The index fell in the rest of the region. Food import and food aid have become a crucial element in the fragile economies of all parties concerned, the factor limiting further increases in domestic agricultural production not being the lack of arable land but water scarcity.

Even Israel, which is self-sufficient with respect to many agricultural products and an exporter of fruits and vegetables, is far from self-reliant in its supply of cereals. But the situation is most strained in Jordan, which has to import 80% of its food. This is one of the reasons for a chronically deficitary balance of trade, and, as a result, one of the highest external debt ratios of the world compared to the GNP. If one considers that half of Jordan's present agricultural production is obtained on irrigated land - which constitutes only 15% of the cultivated area - one gets an idea of how much the performance could be improved if enough water was available (Schiffler 1993: 27).

Table 2.5
Food Security Indicators

	Israel	***Jordan***	***Palestine*** *W.Bank/Gaza*	***Syria***	***Lebanon***
Food production per capita index 1991 *(1979-81 = 100)*	*100*	*89*	*n.d.*	*77*	*136*
Cereal imports plus food aid in cereals 1990 *(in 1000 metric t)*	*1,802*	*1,781*	*n.d.*	*2,113*	*372*
Food share of total imports 1990	*7 %*	*19 %*	*12 % **	*17 %*	*n.d.*
Food import dependency ratio 1988/90***	*n.d.*	*87.2*	*n.d.*	*31.7*	*74.9*
External debt 1991 *(in US$ billions)*	*23 ***	*8.6*	*--*	*16.8*	*1.9*
as percentage of GNP	*35*	*227*	*--*	*104*	*n.d.*

* Data for 1987; ** Data for 1992; *** The food dependency ratio is defined as the ratio of food imports to the food available for internal distribution, that is, the sum of food production plus food imports, minus food exports.
Sources: UNDP: Human Development Report 1994; The World Bank (1992): World Development Report 1992; Fischer Weltalmanach 1995, Frankfurt 1993; Kally, Elisha; Fishelson, Gideon (1993): Water and Peace; Water Resources and the Arab-Israeli Peace Process. Westport/Connecticut, London; Israel Information Service Gopher.

Economic stability - and consequently political stability - in the region depends substantially on the ability of states to secure a sufficient food supply to their people. Therefore, one of the main problems faced by Middle Eastern governments is the provision of food in sufficient volumes and at affordable prices to meet the inevitably increasing demands. According to Allan (1994: 357ff.), food deficit countries can be categorized according to whether or not they can substitute the deficit from their own resources through trade. In the latter case substitution can only be achieved with significant political adjustments to the terms acceptable to an outside patron which is able to provide the needed food.

Unlike the oil-producing countries of the Middle East, which have high revenues from their exports and therefore strong trading positions, the parties to the Jordan Basin watershed belong to the second of these two categories. Their trade balance is chronically negative and, with the exception of Israel, they have very limited resources to improve water management systems and/or diversify their economies. This situation has been described as being subject to 'food politics', food supplies being an important leverage mechanism to the US - as the main cereal supplier worldwide - to advance a pro-American attitude among countries of the region (Allan 1994; also Kliot 1994: 252).

However, the socio-economic impacts of agricultural decline are not the same for all parties involved. The importance of the agricultural sector as measured by its share of the GNP, exports, and employment is much lower in Israel than in the neighboring Arab states and the Occupied Palestinian Territories. It would appear that in Israel reductions in water use by the agricultural sector could alleviate water problems with only small economic and social costs (Brooks & Lonergan 1993: 42). Also in Jordan, the importance of the agricultural sector is below the average of developing countries. The agrarian sector employed about 60,000 people at the beginning of the 1990s, including an estimated 10,000 illegal migrant workers from abroad (Schiffler 1993: 26). In Syria and the Occupied Palestinian Territories, the economic dependency on agriculture is far higher, holding shares between 20 to 30% on the relevant indicators. (See chapter 4.2.4)

Table 2.6
The socio-economic importance of agriculture in the Jordan Basin region

	Israel	***Jordan***	***Palestine*** *W.Bank/Gaza*	***Syria***	***Lebanon***
Agriculture's contribution to GDP 1991	*3 %*	*7 %*	*23/ 29 %**	*30 %*	*n.d.*
Agricultural labor force 1990-92 *(as share of total employment)*	*4 %*	*10 %*	*26.3*	*23 %*	*14 %*
Agriculture's share of total exports 1990	*2.5 %*	*10 %*	*10 %*	*17 %*	*n.d.*

Sources: UNDP: Human Development Report 1994; The World Bank (1992): World Development Report 1992; Data for the West Bank and Gaza Strip from: The World Bank (1993): Developing the Occupied Territories. An Investment in Peace. Report No. 11958 Washington DC; and Awartani, Hisham: Palestinian-Israeli Economic Relations: Is Cooperation Possible. In: Fischer, Stanley; Rodrik, Dani; Tuma, Elias (1993): The Economics of Middle East Peace: Views from the Region. Cambridge/MA, pp. 281-304.

Beyond the strictly economic significance of agriculture, however, one should also bear in mind its socio-political and ecological importance, especially in developing societies;

e.g. providing income to the rural population and thus keeping it from joining the already overcrowded cities, helping to stop desertification, and ensuring a certain degree of food self-sufficiency. Another - intrinsically political - dimension of agriculture is that populating and cultivating the land means controlling it physically and symbolically strengthening the claim over it. Especially in the context of the Arab-Israeli conflict this latter aspect has to be taken into account in order to understand all implications of the water issue (see therefore especially chapter 3.4.1).

2.4.2 Constraints to industrial development

Industrial production also is dependent on an abundant supply of fresh water. Although industrial water consumption varies considerably, depending on the applied processing technologies, one may state as a rule of thumb that up to three liters of water are needed to produce a tin of vegetables, 100 liters for one kilogram of paper, 4,500 liters to produce one ton of cement, 50,000 liters to manufacture a ton of leather, and up to 280,000 liters to manufacture one ton of steel (Clarke 1991: 3). Although industry makes up for only 5 to 7% of total use in the countries of the Jordan Basin region (see Table 2.2), after the domestic sector, it has been the sector with the highest growth rate in water consumption during the last few decades. In Israel, *e.g.*, it doubled from 1960 to 1990 (Statistical Abstracts of Israel 1994).

Energy production, which is at the base of all industrial development, is a good example of the dilemmas which industry faces in a situation of acute water scarcity. All thermal power-generating facilities, whether they use fossil or nuclear fuels or geothermal sources of heat, need a cooling system which in its turn requires water to process (Gleick 1993a: 70f.). The cheapest and most common method is once-through cooling, where large volumes of water are withdrawn from a water body, circulated through the system, and discharged back to the watershed at a higher temperature. If properly managed, most of this water is not lost and can be reused for other purposes, *e.g.* irrigation. But where great amounts of water are lacking, the possibility of reusing the water does not help.

Power plants must then be located on the seashore to use sea water. This option is adopted by Israel. However, the processing costs are higher than in the case of fresh water, and escaping salt-bearing steam can damage nearby agricultural land. Moreover, this system is not applicable to Jordan with its minute shoreline on the Red Sea, far from the great population and industrial centers. Further options consist in using alternative cooling systems like closed-cycle or wet cooling. These have the advantage that the total volume of water needed to run the system is cut down to only a few percent of what is needed in traditional plants. But apart from higher costs, their *consumptive* use - *i.e.* the part of the water definitively lost by evaporation or process losses - is greater than in once-through systems (Gleick 1993a).

Similar problems concern all kinds of industrial plants. A study by the German Development Institute (Schiffler et al. 1994) on 35 major industrial companies from all sectors in Jordan highlights the constraints posed to the industrial sector. 11 out of the 17 companies that depend mainly on the public network declared that they had faced water shortages in the past, primarily during summer. A common solution is the construction of reservoirs, though their size is often insufficient when prolonged shortages occur. Thus, some companies had to rely on water delivered by tankers at highly over-prized costs of up to two Jordanian Dinars (about three US$) per cubic meter. Eight of the 18 companies using private wells stated that the groundwater table had fallen during recent years. They had to drill deeper wells, and were thus faced with additional investment costs. The general ban on drilling new wells forced companies to locate production sites within areas with existing wells. Understandably, the price for such plots of land is far higher than for usual building ground (Schiffler et al. 1994: 20ff.). Another problem is related to water quality. Several companies reported deteriorating water quality, characterized by increasing salinity. Thus 25 out of 35 companies had to treat their fresh water prior to use. The costs of pre-treatment often substantially surpassed the costs of pumping and/or charges by the water authority.

Since available water resources are already fully exploited, it seems inevitable that further industrial development, in Jordan as in the other areas of the region, will need a shift in the sectoral allocation of water. In the present situation this can only mean at the expense of agricultural use. Economically, this would make sense, since the product value of one cubic meter of water consumed in industrial production is very much higher than for the same amount consumed for irrigating wheat fields or orchards. In Jordan, for example, productivity per unit of consumed water is 40 times higher in industry than in agriculture, and employment effect is 13 times higher (Schiffler et al. 1994: 27ff.). Comparable values can be assumed for other countries in the region.

3 Water Disputes and Arab-Israeli Struggle: a Conglomeration of Differing Conflict Settings

The water crisis in the Jordan Basin region is not only a matter of absolute scarcity but also of resource distribution among the riparians of shared hydrological bodies. In fact, apportionment of the region’s water resources has been a continuous matter of dispute in the Arab-Israeli conflict. Water projects in some cases were a trigger and on other occasions a weapon within the frame of the historical struggle. The term "Arab-Israeli conflict", however, still awakens the false idea of a strife between the Jewish State on the one side and a united Arab world on the other. Despite the occasional revival of pan-Arabic rhetoric at summit meetings, and the propaganda of some Israeli lobbyists continuing to paint the picture of a minute state surrounded by a uniform and menacing Arab land mass, this setting no longer corresponds to reality. In the last 30 years a process of differentiation has occurred in the region.

Firstly, the emergence of a Palestinian nationalistic movement since the beginning of the 1960s and the prolonged permanence of a great part of the Palestinian people under

Israeli occupation since 1967 have established a partially independent, specific Israeli-Palestinian track of the conflict. Secondly, the Arab world itself experienced a process of progressive disintegration. Jordan did not participate in the fourth Arab-Israeli War of 1973. In 1979, Egypt signed the separate peace of Camp David. Other countries like Morocco have also been maintaining friendly relations with the Jewish State. Finally, the Second Gulf War definitively revealed deep divisions between the Arab states, which do not seem likely to be cemented soon.

In the current Middle East peace process Israel negotiates with each of its immediate neighbors separately. It is true that this was a pre-condition of the Jewish State to consenting to the Madrid opening conference, since it did not want to find itself alone against several opponents. But it also corresponds to the differing interests manifest in each track of the conflict. This holds true for both the political core issues and water-related disputes. It is a central thesis of this paper that, although all bilateral trails of the conflict deal in principle with distribution of shared resources, the relative weight of water disputes and their interconnections with traditional concerns - political and territorial - are quite different within each.

Therefore, the following chapter analyzes the water disputes in the Jordan Basin region from the perspective of each single bilateral trail of Arab-Israeli negotiations. Since the evolution with time of water disputes has already been examined in depth by many other good studies (among others Naff & Matson 1984; Lowi 1993; Kliot 1994; Wolf 1995), the present analysis focuses on the situation at the beginning of the current peace process in the early 1990s. Historical background is outlined only in brief, as far as it seems indispensable for further argumentation.

3.1 A genuine water dispute in Israeli-Jordanian negotiations

3.1.1 Historical background

The Israeli-Jordanian water struggle has always been at the core of the Arab-Israeli water conflict. Disputes mainly concerned the utilization of the Jordan and Yarmouk rivers. The streams belonging to the Jordan catchment are the only noteworthy surface water crossing both countries. In both cases they are the most important single source of water, accounting for more than one third of the national supply. Disputes began in the late 1940s, when both countries started with ambitious water development programs (see chapter 1.3.1.2). At the time, the bilateral conflict over water was clearly embedded in the broader context of the struggle between Israel and the Arab League (see also chapter 3.2.1).

In the early 1950s, the US administration became actively involved in Jordan Valley water planning. In four difficult rounds of talks, Eric Johnston, a special ambassador appointed by President Eisenhower, tried to negotiate an integrated development plan and a water-sharing regime between all the riparian states. The greatest beneficiaries would have been Israel and Jordan. However, the agreement accepted by the technical committees of all the parties concerned was never ratified on the governmental level because of the overwhelming political conflict. The Arab states were concerned about the fact that their consent to a water-sharing regime with Israel would imply *de facto* recognition of the Jewish state (Wishart 1990). Lowi (1993: 193) suggests that even more than the issue of non-recognition the matter of distribution of relative and absolute gains was determinant in the Arab’s refusal to engage in joint water management with Israel: "In sum, the Arabs would not support a project that would strengthen their enemy".

Table 3.1
Water allocations according to Johnston’s Unified Plan of 1955

	Upper Jordan River	Yarmouk River	Total
Israel	375 *	25	400
Jordan	100	377 *	477
Syria	42	90	132
Lebanon	35	-	35

* According to the "Gardiner Formula" Israel’s share of the main stream of the Jordan River and Jordan’s share of the Yarmouk were defined as the "residue" after the other co-riparians had received their fixed shares. This would vary from year to year, but was expected to average 375 mcm for Israel and 377 for Jordan. Jordan would also get 243 mcm from side wadis in the Lower Jordan Valley which were not shared resources in the proper sense at the time, since Jordan itself was the sole and last riparian on that track of the river.

After that episode Israel and Jordan realized their planned projects unilaterally, the first mainly on the Upper Jordan River, the second on the Yarmouk. Temporarily, both sides followed allocations proposed in the Unified Plan. Tacit agreement was encouraged by the United States, which granted funding for water development projects only as long as the Johnston stipulations were adhered to. However, the growing water demands and the political consequences of the Six Days’ War of 1967 soon blasted these informal provisions. During the war, Israel destroyed the works of a Jordanian dam on the Yarmouk. By occupying the Golan Heights, Israel gained complete control over the Upper Jordan River and over a longer portion of the northern shore of the Yarmouk, including the area facing the intake of Jordan’s King Abdullah Canal (former East Ghor Canal).

3.1.2 The Israeli-Jordanian water dispute setting at the beginning of the 1990s

Since the Six Days’ War, due to its downstream position on the Jordan River and its weak strategic standing on the Yarmouk, Jordan has been greatly disadvantaged in its water use opportunities. Since the late 1960s Israel has virtually monopolized the waters of the Upper Jordan. Jordan has been totally excluded from tapping this source, despite its having been allocated 100 mcm (or about 18%) of the Jordan’s water in the Johnston Plan. On the Yarmouk, Jordan suffered from long-standing Israeli obstructionism against building a storage system to improve water diversions into the King Abdullah Canal. After destroying the initiated dam during the war, in 1969 Israel again flew a raid against Jordanian water facilities, as retaliation for the repeated infiltration of Palestinian 'fedayn' from the Kingdom’s territory. This was the prelude to expulsion of the PLO by the Jordanian Army in the 'Black September' 1970 (Wolf 1995: 54f.). Israel subsequently impeded, at repeated occasions, the neighboring state in accomplishing maintenance works at the intake of the King Abdullah Canal. Until recently, Israel has vetoed the World Bank financing a joint Jordanian-Syrian dam at Makarin.

In the 1970s Israel itself began to divert greater amounts of Yarmouk water into Lake Tiberias. According to the estimations of several independent experts, these extractions rose up to 100 mcm in the mid-1980s (Lowi 1993: 181; U.S. Army Corps of Engineers 1991). Later, these Israeli extractions seem to have been reduced during the years of drought between 1987-1991. In the Israe-Jordan peace negotiations 70 mcm were assumed to have been the long-term average Israeli extractions from the Yarmouk (Hof 1995: 48ff.). This is still considerably more than the 25 mcm foreseen in the Johnston Plan. Because of this, and due to increasing Syrian diversions on the upstream tributaries, the Jordanian quota on the Yarmouk remained restricted to just 120-130 mcm yearly (see also chapter 1.3.1.2). This is three times less than the allocation expected in 1955.

A last source of some importance to Israeli-Jordanian relations are the groundwater resources of the Arava Valley extending from south of the Dead Sea to the Gulf of Aqaba on both sides of the international boundary. This area is very arid, with precipitations below 50 mm per year. The only water available can be found in subterranean basins, some of which are common to Israel and Jordan. Both countries have been implementing a variety of agricultural schemes on their respective sides of the border. Since there has been no coordination of activities, pumping was competitive, resulting in rapid depletion of the supplies and their increasing salinization (Lowi 1993: 182). The water-sharing dispute is in part related to territorial controversies concerning some small plots of land which Israel conquered in the first Arab-Israeli War of 1948. Israeli farmers have been cultivating the land and using the wells located on it. However, the water amounts in question are limited. So far, Israel and Jordan seem to have been utilizing 8 and 4 mcm respectively from these sources. Thus, neither party perceives these supplies to be nearly as significant as the waters from the Jordan-Yarmouk system (see also chapter 5.2).

Table 3.2
De facto distribution of the Jordan and Yarmouk waters in the early 1990's

	Upper Jordan	***Yarmouk River****	***Total***
Israel	*ca. 550*	*70-100*	*640-660*
Jordan	*0*	*120-130*	*120-130*
Syria	*0*	*150-240*	*150-240*
Lebanon	*0*	*is not riparian*	*0*
West Bank	*0*	*0*	*0*

* Data on the utilization of the Yarmouk belong to the most controversial figures in the Arab-Israeli water disputes. The figures given here reflect the range of estimations given by *independent* sources.
Sources: US Army Corps of Engineers (1991): Water in the Sand: A Survey of Middle East Water Issues. Washington DC; Beschorner, Natasha (1992): Water and Instability in the Middle East. Adelphi Paper, No. 273. London; Lowi, Miriam R. (1993): Water and Power: The Politics of a Scarce Resource in the Jordan River Basin. Cambridge.

At the beginning of the peace negotiations, the Jordanian demand for redistribution of the regional water resources belonged to the most important contentious in the bilateral relations with Israel. Jordan criticized the uneven allocation, as it had emerged from unequal geographical chances to tap the rivers and the power ratio between the two countries. Israel’s extractions from the Yarmouk, and its obstructionism against Jordan building its own long-aspired dam on the same river were viewed as a violation of Jordan’s vital interest. In 1990, at the peak of the drought period, when disputes rose over water allocations on the Yarmouk, King Hussein stated in an interview that water was the only reason that could again bring Jordan to war with Israel (*The Independent*, 15 May 1990). In its argumentation, Jordan used to bring up the Johnston Plan, which, although not legally binding, had been the only existing point of reference for an agreed water sharing in the region (Haddadin 1992).

Israeli authors, in their turn, argued that Johnston’s stipulations could no longer be taken as a basis for a settlement, since the Arab League rejected the plan at the time, and because the geopolitical situation had changed substantially since then. Moreover, through Israel’s territorial gains in the Six Days’ War its water entitlements were also supposed to have risen (Soffer 1994; Schiff 1994a).

The Israeli-Jordan Common Agenda of September 1993, aimed at defining the path for further talks, highlighted the paramount importance given to the water issue. Article 3 of the Common Agenda explicitly names "securing the rightful water shares of the two sides" as one of four main components to be dealt with in the negotiations. This put the water problem on the same level with security issues (named first), as well as the question of Palestinian refugees and minor border and territorial matters (both named after the water issue).

The Israeli-Jordanian water dispute concerned allocation quotas and the building of storage and diversion facilities on a shared river basin. Thus it was basically a distribution conflict, showing all the characteristics of a zero-sum game. On the other hand, the bilateral Israeli-Jordanian water dispute was the only one in the Arab-Israeli frame not directly interwoven with border or other highly politicized disputes. Historically, the Israeli-Jordanian relationship has been the least tense among all the relations between the Jewish State and its direct neighbors (except Egypt). Since 1988, when King Hussein of Jordan officially gave up his claims to the West Bank in favor of a Palestinian solution, no territorial differences remained between the two countries except a few small lots of land in the Arava Valley and in the very north of the common border. But these areas neither represented a vital issue for the two sides nor they did imply control of or entitlement to critical water sources. The hydrological disputes between the two countries could therefore be regarded, at least since 1988, as a *genuine water conflict*. Although the conflict was long-standing and concerned considerable amounts of water in a context of severe scarcity in both countries, it did not commingle with other strategic interests. Within the frame of comprehensive bilateral peace negotiations, the water issue could be addressed - and finally resolved - as such, free from extraneous concerns (see therefore chapter5.2).

3.2 The Jordan River’s headwaters as a security matter in Israeli-Syrian-Lebanese relations

The same cannot be said about water in Israeli-Syrian and Israeli-Lebanese relations. These two trails of the peace negotiations are treated together because they are related politically and because the role water plays in the two tracks is similar. In both cases, the main points of dispute are territorial and security matters, namely the question of sovereignty over the Golan Heights and conditions for an Israeli withdrawal from the so-called "Security Zone" in Southern Lebanon. Moreover, Israeli-Syrian relations especially are overshadowed by the bloody wars fought against each other in the past, the persisting arms race between them, by Syria’s support for radical groups opposing the peace process, and by competition between the two countries concerning their influence over Lebanon. Both countries have troops stationed in the latter country, in part justifying this by the presence of the other. The Israeli-Syrian and Israeli-Lebanese trails also belong together because of Lebanon’s vassal-like relation towards the Syrian regime and the influence which the latter exercises over anti-Israeli militias acting from Southern Lebanon. In both cases, as we shall see, the water conflict is to be seen more as a part of these primarily security-oriented concerns than a genuine issue on its own.

3.2.1 Historical background

In the 1950s and 1960s the Jordan River had repeatedly been at the center of conflict on Israel’s northern boundaries. A first dispute concerned the demilitarized zones on the Israeli-Syrian border after the Arab-Israeli war of 1948-1949. These zones were those areas of the British Palestine Mandate which Syria succeeded in occupying during the war. They comprised three areas of land, one of them on the eastern shore of Lake Tiberias, the others in the Upper Jordan Valley. According to the UN-brokered armistice agreement, Syria was to withdraw its troops in return for a pledge that sovereignty of the disputed areas would remain undetermined until a peace settlement had been achieved. Subsequently differing interpretations of the demilitarized status of those areas caused repeated clashes and complaints. Since the zones gave access to Lake Tiberias and in one case crossed the Jordan River, these disputes were mostly triggered by hydropolitical matters.

The first case concerned the Israeli plan in 1951 to drain the Hula swamps in the Upper Jordan Valley. This would have impinged on areas included in the central demilitarized zone. Syria regarded this as an infringement of the armistice agreement and reacted militarily. In the same year, Israel began the construction of its National Water Carrier. In a first version of the project, it planned to tap the Jordan River at Banat Yakoov upstream to Lake Tiberias, a location situated in one of the demilitarized zones. Again Syria deployed its armed forces along the border and artillery units opened fire on the construction and engineering sites. Israel was then convinced to stop the project by the United Nations Truce Supervision Organization (UNTSO) which was charged with control of the armistice agreement, and by the US government. In order to put pressure on the Israeli government the US threatened to withhold $ 26 million of pending financial aid (Neff 1994: 29ff.). Later, Israel moved the diversion site to its current site at Eshed Kinrot, on the northwestern shore of Lake Tiberias.

Water was again at the center of the conflict in the mid-1960s when the Arab League launched the plan to divert those sources of the Jordan (Banias and Hasbani) which arise on the Golan and in Southern Lebanon (see chapter 1.3.1.1, especially Map 1.2). The project, decided on in 1964, was part of a broader anti-Israeli campaign which had been provoked by Israel's announcement that the beginning of pumping into the National Water Carrier was imminent. Technically difficult, with water to be pumped as high as 350 meters, and economically inefficient, the Arab plan was clearly politically motivated. Above all, the diversion would have cut the installed capacity of the Israeli Carrier by one third and increased the salinity of Lake Tiberias, thus collapsing Israel's water supply system (Wolf & Ross 1992: 937). Israeli leaders repeatedly warned the Arabs that the Jewish state regarded the continuity of the water flow as a matter of vital interest, and the Israeli army and air force attacked the work sites of the project several times between 1965 and 1967 (Lowi 1993: 125). These skirmishes incontestably belong to the prelude of the Six Days' War. Although water was not a trigger of the war itself, the abovementioned events set off what Nadav Safran (as quoted by Cooley 1984: 16) has called "a prolonged chain reaction of border violence that linked directly to the events that led to war" in June 1967.

The territorial outcome of the Six Days' War radically changed Israel's hydropolitical position. By conquering the Golan Heights, it thwarted the Arab diversion plan and achieved total control over the Banias source of the Jordan River. On the Hasbani it got strategic control, since its course stretches only a few kilometers from the Heights. Later, after the Lebanon campaign of 1982 and retention of the "Security Zone", Israel also got physical control over the Hasbani. Furthermore, the Jewish State now controls the whole eastern shore of Lake Tiberias and the mountains dominating this water body. Up to 1967, the border between Israel and Syria passed only about 10 meters from the northeastern shore of the lake. Syria took over the narrow strip and claimed use rights on the lake. Interference with Israeli fishing activities repeatedly lead to military incidents. Syria also threatened to contaminate the lake in retaliation for Israel’s water withdrawals.

3.2.2 The Israeli-Syrian water dispute setting

From an Israeli point of view, a return to the hydropolitical situation before 1967 on the northern border with Syria seems highly undesirable, at least in the present climate of mutual fear and mistrust. After a shift in the overall strategic situation in the wake of the collapse of the Soviet Union and Iraq’s defeat in the Second Gulf War, water even seems to have gained in weight over traditional, strictly military concerns. Several articles by Ze’ev Schiff, one of Israel’s most authoritative security analysts, clearly emphasize the hydropolitical argument. In outlining Israel’s minimal conditions for a withdrawal on the Golan, Schiff (1994b) counts the traditional security requirements as belonging to the "*operational* sphere" (they concern defense of the Galilee), while "the need to protect the sources of the water is a *strategic* need" (emphases by the author).

Schiff proposes to realize water-related security needs by territorial adjustments which would incorporate the escarpment surrounding Lake Tiberias and the sources of the Banias into Israeli territory. These proposals are based on a 1991 report commissioned by the earlier Israeli government and conducted by Jehoshua Schwarz and Aaron Zohar under the auspices of the Jaffee Centre for Strategic Studies. The report had been classified because it contained maps outlining possible withdrawal lines on the Golan heights and the West Bank that would safeguard water sources currently used by Israel. However, excerpts of the report, including the maps, were leaked to the press in late 1993 and published in an article by the same Schiff in *Ha’aretz* newspaper and then in an English version in *Policywatch* (Schiff 1993a; see also Brooks & Lonergan 1994: 205ff.).

Interestingly enough, for Schiff hydropolitical concerns are a more decisive reason for territorial claims than traditional military security issues. According to him, the defense requirements can be implemented by phasing the withdrawal in different stages, retaining a few early-warning posts, and establishing demilitarized areas on both sides of the border. They do not necessarily require territorial adjustments. It is fair to assume that when representatives of the Israeli government insist on territorial compromises on the Golan, water is of critical importance for them, too. On the Israeli-Lebanese trail, Schiff claims guarantees concerning the continued flow of the Hasbani as a condition for settlement.

Map 3.1
Israel's Maximum Water Withdrawal Lines for the Golan
(According to the Schwarz/Zohar Report as quoted by Schiff)

Source: Brooks, David B.; Lonergan, Stephen C. (1994): Watershed: The Role of Fresh Water in the Israeli-Palestinian Conflict. International Development Research Centre: Ottawa; p. 206.

Even assuming that Israel will agree on total withdrawal from the Golan, another water-related dispute concerns the precise location of the Israeli-Syrian border. This question refers to the problem of demilitarized zones in the aftermath of the Arab-Israeli war of 1948. When Syrian officials and - uncritically - most journalists also, speak of total withdrawal from the Golan heights, they usually refer to the frontiers as they were on June 4, 1967. Implicitly, this would again raise Syrian claims over those zones, the status of which had remained unclarified until that day. On the other hand, when indicating the possibility of total retirement from the Golan, Israeli representatives always refer to the international boundaries of the Palestine Mandate as set out in 1923, thus including the demilitarized zones within the borders of Israel (Foreign Minister Peres as quoted by Schiff 1995b).

The question is related to water since the areas in question cross the Jordan River in one section and represent parts of the shores of Lake Tiberias in another (see above chapter 3.2.1). By extending its sovereignty over the formerly demilitarized zones, Syria could demand part of the water rights to the lake and/or obstruct Israeli diversions. However, legally and politically, it seems unlikely that the outcome of negotiations could be Israel's release of all the territories it conquered in the 1967 war, while Syria would be allowed to retain those territories which it in turn appropriated militarily in 1948.

Judging on this basis, the struggle over the headwaters of the Jordan River cannot be regarded as a genuine water conflict as in the case of Israeli-Jordanian dispute. This is emphasized by the fact that the resources in question are not of the same importance for the three parties involved. From an Israeli point of view, water originating on the Golan Heights and Southern Lebanon represents more than 50% of the supply feeding the Upper Jordan River and Lake Tiberias, Israel's main water provider. On the other hand, these sources potentially represent no more than a few percent of total water supply in Syria and Lebanon. For these two countries the streams might be of local but not national importance, since both are crossed by far more important rivers (see also chapter 1.2). As stated, the project to divert the Jordan's headwaters in the 1960s was motivated politically and not economically.

Consequently, water disputes must be regarded as part of the security dilemma in this trail of the Middle East peace negotiations. As long as the political differences and the climate of mistrust between the parties persist, water will be perceived as a potential 'weapon'. In turn, territorial claims resulting from that perception complicate a resolution of the conflict's political core issues. In a hypothetical context of comprehensive peace and trust, water would lose that strong security connotation. In such a situation, the hydropolitical goals, which Israel now pursues by retaining territory, could also be achieved by legal agreements. An arrangement would have to allocate a small portion of the water to the local population on the Golan and in Southern Lebanon while the bulk of the flow ought to remain Israel's property. The water distribution conflict proper thus seems not to be unresolvable in this case. Rather, the replacement of the current Israeli policy of physically controlling its water sources by a legal regime is subordinate to resolution of genuinely political and strategic concerns.

3.3 The Israeli-occupied "South Lebanese Security Zone" and the question of water deliveries from the Litani River

Somewhat different from the question of the Jordan River's headwaters is the issue of the Litani River which plays a certain role in Israeli-Lebanese relations. As stated in chapter 1.3.2, the Litani is a stream flowing entirely within the territory of Lebanon, with no connection to the Jordan River watershed. However, there has been a long-lasting interest by Zionist and later Israeli politicians in the waters of this river dating back to the beginning of the century when the first plans to found a Jewish home in Palestine were born. At the Paris Conference marking the end of World War I the Zionist World Organization proposed to include the lower course of the Litani into the British Palestine Mandate. Later, Israel tried to include the Litani waters into the Johnston negotiations over a regional water-sharing regime. The Israeli invasion of Southern Lebanon in 1982 and the permanent occupation of a strip of land including a bit of the lower course of the Litani after its partial withdrawal in 1985 raised new fears that those projects to divert the Litani waters southwards would now be put into practice. Lebanese newspapers and politicians repeatedly accused Israel of working on a diversion scheme or even having already begun to extract water (see Amery 1993; Amery et al. 1994; Cooley 1984).

These accusations have always been rejected by Israel. Past interest in the Litani is acknowledged, but present occupation of the "South Lebanese Security Zone" is justified by military defense concerns alone. It is true that after the invasion of 1982, Israeli army engineers seized all hydrologic charts and technical documents about the Litani and its hydroelectric installations. Israel's former Technology Minister Neeman also confirmed in an interview that seismic soundings and surveys had been undertaken near the Litani's western bend, most likely to determine the optimum route for a diversion tunnel (Cooley 1984: 23f.). But best evidence indicates that there have been no Israeli withdrawals from the Litani River to date, except for supply of stationed troops, nor construction of infrastructure to support such a withdrawal. Several times UNIFIL officers stationed in the zone were commissioned to check those allegations, but always denied them (Hottinger 1992: 156). Moreover, the flow of the Litani has been diminishing in its lower course in the last decades due to Lebanese diversions upstream, both for irrigation and power generation. The remaining usable flow amounts to no more than 125 mcm, thus diminishing Israeli interest in a great diversion scheme (see chapter 1.3.2).

On the other hand, the idea of increasing Israel's water supply by importing water from the Litani has not been put *ad acta*. Several Israeli experts continue to propose diverting the remaining Litani waters to the south as a means of alleviating water scarcity in Israel (among others Kally & Fishelson 1993: 94ff.). It seems unlikely, however, that Israel would attempt a unilateral diversion of the Litani without an explicit agreement. Rather, Israel may try to put water deliveries on a commercial basis on the agenda of Israeli-Lebanese negotiations as one condition for a troop withdrawal. According to what former Lebanese Foreign Minister Elie Sale told his parliament, back in 1982-1983, during Israeli-Lebanese negotiations on a partial troop withdrawal, Israel seems to have informally demanded buying water and leasing land (*Middle East Reporter*, 16 February and 14 April 1988 as quoted by Sirriyeh 1989: 40f.). Yet the issue was not resolved, and could be raised again when current peace negotiations between the two countries reach an operational stage.

3.4 The struggle over water rights as an integral part of the Palestine Question

3.4.1 Historical background

On a local level, water conflicts between Palestinian and Jewish communities over the utilization of single sources and wells date back to the very beginning of Jewish immigration to historical Palestine. However, as a wider conflict, Israeli-Palestinian water dispute came onto the political agenda following the formation of a Palestinian nationalistic movement in the early 60s and the Israeli occupation of territories with a homogenous Palestinian population in the Six Days' War. Almost immediately after the war, Israeli water policies and institutions were extended to the Occupied Territories. A series of military orders put exploitation of water resources under strict control of the Israeli administration, severely limiting Palestinian use. For example:

- Palestinian drilling of wells is forbidden without permission by the Israeli authorities. Since occupation, permits have been granted for just 23 wells, mainly to replace older wells which had dried up. Only three of these permits concerned wells for agricultural use (Isaac 1995; Israel Foreign Ministry 1991). As a consequence, Palestinian agricultural water consumption remained at the 1968 level in absolute terms. Only domestic use increased by 20%, not even keeping pace with population growth.
- On the West Bank, Palestinians are only allowed to drill shallow wells of 60-140 meters; Mekorot, the contractor of Israel's water authority supplying the Jewish settlers, prefers to drill to depths of 300-400 meters, in order to get higher flow rates and better quality water. In some cases, the deeper wells drained water from the shallower ones, leading to the drying up of Palestinian wells, notably in the Jordan Valley and the al-Auja and Bardala area.
- Reforestation is prohibited in the recharge area of the aquifer, except on private plots, in order to promote maximum run-off and thus recharging of the aquifer (Brooks & Lonergan 1993: 73f.; Cooley 1984: 16f.; military orders touching water issues are documented in Jerusalem Media & Communication Centre 1994: 43f.).

By these measures, Israel is preventing the Palestinians from developing the groundwater resources of the West Bank in accordance with their growing social and economic needs. Since the aquifer is transboundary, this assures unaltered water flow into the Israeli territory. In the meantime, Israel built new Jewish settlements in the

Occupied Territories. At present, about 140,000 Israeli settlers live on the West Bank and about 3,000-4,000 in the Gaza Strip, in addition to about 160,000 in East Jerusalem *(Neue Zürcher Zeitung,* 18 January 1995, according to figures given by the settlement movement itself; and others). Since settlements are usually supplied with water from local sources, they increased the burden on the limited water supply in the Occupied Territories. Moreover, to exacerbate tensions between settlers and the indigenous Palestinian population, the settlers are systematically favored over their Palestinian neighbors regarding water allocation, regularity of supply, and pricing. While in 1992 Jewish settlers on the West Bank had at their disposal 50 mcm of water for a population of approximately 125,000 at the time, Palestinian consumption amounted to 110 mcm for more than one million people, thus showing a ratio in per capita use of nearly 4 to 1 in favor of the settlers. In the Gaza Strip, despite relatively low total consumption by the settlers (due to their limited absolute number), per capita ratio of use between the two communities shows even more disproportionate levels of 12:1 and more (Assaf et al. 1993: 98; see also chapter 1.4.2).

3.4.2 The Israeli-Palestinian water conflict setting

As a result of these policies, Israel, including the settlers, is presently utilizing nearly 80% of the shared waters of the West Bank, while Palestinians are left with less than 20%. To compound the inequity, Palestinians on the West Bank are forced to pay higher rates for their water supply. Many different figures have been published on this matter (*e.g*. Elmusa 1993: 75; Beschorner 1992: 14; Brooks & Lonergan 1994: 92). These reflect variations between areas and whether Palestinian consumers are supplied by Mekoroth or by local Arab sources. However, all agree that there is a high imbalance between prices paid by the settlers and those demanded of their Palestinian neighbors. According to Brooks & Lonergan (1994: 92), Mekoroth charges Palestinian municipalities 1.8 New Israeli Shekels (NIS) - about US$ 0.90 - per cubic meter and 2.1 NIS for individuals, whereas it charges Israeli settlements only 0.5 NIS on the West Bank and 0.3 in the Gaza Strip. They conclude "that the issue is not the absolute price that Palestinians pay for water, which may indeed reflect real costs. The issue is one of blatant and formalized discrimination on the part of the Israelis".

Table 3.3
The Distribution of West Bank Waters

	in mcm/year	*in %*
Israel	*413*	*65*
Settlers	*50*	*17*
Palestinians	*110*	*8*
Unused	*58*	*9*

Source: Assaf, Karen; al Khatib, Nader; Kally, Elisha; Shuval, Hillel (1993): A Proposal for the Development of a Regional Water Master Plan. Israel/Palestine Center for Research and Information IPCRI: Jerusalem.

Palestinians have ever objected to the increasing control and integration of the West Bank's water resources into the Israeli grid. Legal arguments by the Palestinians often refer to the Hague Regulations of 1907 and the Fourth Geneva Convention of 1949 on the powers and duties of a belligerent occupier. These international treaties forbid an occupier to transfer its civilian population into occupied territory. Moreover, they place severe restrictions on the occupier's right to exploit both private and public property, such as land and natural resources, for purposes other than the occupation itself (Watzal 1994: 50ff.). Thus establishment and permanent extension of Jewish settlements and their supply with local water resources at the expense of the indigenous population is seen as a flagrant breach of recognized international norms. Nationalization of all water resources is regarded as a confiscation of private property, which also infringes upon the conventions, since under previous Jordanian rule water rights were often related to land ownership (Dillman 1989; Palestinian Hydrology Group & Palestinian Advocates Group 1992).

The Israeli government claims that, by occupying the West Bank and Gaza Strip in 1967, it has not displaced a legitimate sovereign, since Jordan and Egypt themselves illegally occupied these territories in 1948. Hence, the West Bank and Gaza Strip are not seen as territories falling under jurisdiction of the signatories of the Hague and Geneva Conventions (Dichter 1994). Following this argumentation the territories captured from Jordan and Egypt in 1967 are officially not referred to as "occupied", but just as "administered" by Israel. In the last resort, this very finicky legal argument views the West Bank and Gaza Strip as a sort of no man's land where universally accepted rules of international law do not fully apply.

Israel's argumentative standing is somewhat stronger regarding water use from within Israeli territory proper. Here it argues that water is not being exported from the Occupied Territories but rather flows naturally seaward. Because Israel tapped most of the water even before the Six Days' War, it feels it has 'prior appropriation rights'. However, according to international customary law, the right of prior use is just one among several criteria to be taken into account in distributing international water bodies (see chapter 5.1). Moreover, after 1967 water extractions from within the 'Green Line' have increased. This expansion took place under compulsion, thus having no legal standing.

A further water dispute between Israel and the Palestinians concerns the Palestinian claim on a share of the Jordan River. The Palestinians are now totally excluded from using the river, though the West Bank is a full riparian for a length of about 60 kilometers and even takes its name because of its location relative to it. According to informal provisions in the Johnston negotiations of 1955, 70-150 mcm of Jordan-Yarmouk waters were supposed to be used on the West Bank. They made up part of the Kingdom of Jordan’s share (Wolf & Ross 1992: 947).

In the Gaza Strip, the hydropolitical situation is the opposite of that on the West Bank. Since the Gaza aquifer is in part recharged by water inflows from the adjacent Israeli territory, replenishment depends on Israeli behavior. Palestinian sources claim that, due to groundwater extraction by Israeli wells near the border and construction of low dams upstream in Wadi Gaza, Israel is diminishing the natural recharge of the aquifer (Palestinian Environmental Protection Authority 1994: 21; see also chapter 1.4.2). Palestinian authors often point out the contradiction between Israel’s insistence on its downstream riparian rights to the West Bank groundwaters on one hand, and its practice of making the best use of its upstream position in the case of the Gaza Strip aquifer on the other.

According to the former deputy mayor of Jerusalem, Meron Benvenisti, "these [Israeli] policies denied the Palestinians the possibility of developing competitive water-intensive farming techniques to put irrigable land to full use and exposes them to the vagaries of natural rainfall" (quoted in United Nations, ECOSOC 1985: 182). In fact, while settlers on the West Bank are able to irrigate nearly 70% of their cultivated land, a ratio which is even higher than in Israel proper, all but 5-6% of Palestinian land on the West Bank is purely rain-fed (Isaac 1995). Compared to their Israeli competitors, Palestinian farmers are clearly disadvantaged concerning water availability and costs. Combined with confiscation of agricultural land for settlers as well as other restrictions on Palestinian land use, these practices have encouraged many Palestinian farmers to abandon their original activity and move to towns, often becoming unemployed or day laborers within Israel. Moreover, according to laws applied by the Israeli administration, uncultivated land is easier to confiscate or to declare a closed area than a cultivated one. One might therefore assume that Israeli water policies have been specifically used to enforce a slow but persistent process of appropriating the Palestinian homeland.

In a first view, the Israeli-Palestinian water dispute seems to be a classic distribution conflict over shared resources of vital importance to both sides. From the Israeli perspective, one-quarter of the country’s present water supply and an even greater part of its drinking water is tapped from the aquifer underlying the West Bank and the adjacent Israeli territory. Westward-flowing underground water also helps stabilize pressure and prevent Mediterranean water from intruding into Israel’s own coastal aquifer. Limiting Palestinian consumption is therefore viewed by Israeli authorities as a defensive measure, of sorts. Israel has been tapping 270 mcm/year of the aquifer from its side of the Green Line since 1955. The fear is that any uncontrolled, extensive groundwater development by Palestinians on the West Bank would threaten the yield of Israel’s own wells. Moreover, inappropriate management of the shared aquifer might lead to irreversible damage by pollution and/or salinization (Wolf & Ross 1992: 944f.).

The Palestinians object that the increasing control and integration of the Occupied Territories’ water resources into the Israeli grid is done at their expense. They claim that more than 90% of the flow of the Western aquifer and 100% of the Northeastern one are fed by rainfall over the West Bank. Thus water should primarily be allocated for their use. This demand is no less urgent and legitimate than the Israeli concerns, since water from the common aquifer is the only source of supply of the Palestinians on the West Bank and the main source of the Occupied Territories as a whole. An increase in their share of the groundwater is seen as essential for improving the poor standard of living in the territories and their future economic development (see also the well done survey on Israeli-Palestinian claims and counterclaims in Shuval 1993a: 48ff.).

However, the Israeli-Palestinian water dispute is not just a simple distribution conflict, as it may superficially appear. The difference is that the competing parties in question are not two formally equal sovereign states. Unlike the Israeli-Jordanian case, for instance, the water dispute here is between an established and powerful state on one side, and a people in search of statehood on the other. The chances to use common water resources are therefore not determined by a mixture of geographical factors and power ratio, as in 'normal' international basins, but by political circumstances alone. Despite being lower riparian of the Mountain Aquifer, through its military occupation of the West Bank Israel is in the position to deliberately fix the use quota of its competitor, the Palestinians. Thus the geographical setting is completely distorted. Given this situation, the dispute over water is intrinsically embedded into the struggle over land and national identity at the core of the Palestine question. Speaking about the ongoing peace negotiations aimed at finding a solution to the Israeli-Palestinian conflict, water directly touches all political and territorial main issues in question.

1. The *nature of the Palestinian political entity* which is supposed to be established in the Occupied Territories as an outcome of the negotiations is intimately linked to the powers this entity will have over natural resources. Whether it will be an independent state or state-like entity, or just an autonomous body with administrative powers over people, will influence its ability to reclaim own "water rights". The latters are understood as sovereignty rights over state land and *national* resources (in opposition to the simple *individual* human right to a life-sustaining water supply). From the Palestinian perspective, the claim to water rights is a logical and integral

part of their national aspirations. From the Israeli viewpoint, this might be one of the reasons for denying them a full right to statehood.

2. The future of *Jewish settlements* in the Occupied Territories is obviously linked to the water dispute. Since the settlements are mainly supplied with water from local sources, their consumption occurs directly at the expense of the Palestinians. As long as the settlements remain in the territories, this will always raise the question from which sources and according to which standards they will be supplied.

3. Relating to the permanent status of the Occupied Territories, the dispute over water rights is narrowly linked to the question of the *definitive borders* of an eventual Palestinian state. The territorial extension of Palestine will determine access to wells and springs, and consequently the claim to water rights and shares. The question is very delicate because the storage area of the Mountain Aquifer where the best pumping sites are located stretches along the plain on both sides of the border between Israel and the West Bank. Although not specifying details, Israeli officials always stress that an eventual independent Palestinian entity will not encompass the whole West Bank but that Israel will insist on territorial adjustments. Now, Israeli strategists who are designing plans for the permanent settlement propose to shift the border between Israel and the West Bank to the West, annexing just that strip of land near the western border where most wells and springs are located (see the Schwarz-Zohar report mentioned in chapter 3.2.2 as quoted in Schiff 1993a). The argument that the strip in question is only a few kilometers large and that ceding part of this area could be compensated by territorial exchanges in other sections of the border (Alpher 1993) is misleading, since by that shift the Palestinians would lose the greatest part of their water resources.

4. Finally, even the *Palestinian refugee* and *East Jerusalem question* indirectly relate to water. Whether or not all (or eventually a part) of the refugees will receive a 'right to return' to the new Palestinian political entity will substantially affect overall water demand in the region. And depending on whether East Jerusalem will definitively be added to Israel, included into the Palestinian political entity, or have a special status of its own will change demographic patterns and thus support different needs and claims of the two sides regarding water quotas.

Solution of this highly intricate conflict seems very difficult. On one hand, the water issue is entwined with highly politicized issues on which the parties’ positions remain very distant from each other. In the meantime, the water distribution conflict concerns sources and quantities which - although to a different degree - are of paramount importance to both sides.

4 Water Management Options for the Jordan Basin Region

Traditionally, two distinct approaches to water conflict management and resolution in the Jordan Basin region have been proposed. The first, which we will call the *technical* approach, refers to *water management* in the narrow sense of the term. Water management has been defined as "the skill to bring water supply into line with demand at the lowest possible economic and ecological costs" (Schiffler 1995: 16). This approach views the problem from the perspective of the environmental and socio-economic crisis as described in chapters 1 and 2. Roughly, one can distinguish between supply- and demand-oriented water management options (Berkoff 1994: 20).

The second approach, which will be referred to in the following as the *political* one, views the water conflict as a question of shared resources distribution. The instruments resorted to for dealing with the problem from this perspective belong to the field of international law and might be called *water diplomacy*. This discussion, as well as the results achieved so far in the Middle East peace negotiations, will be presented in the next chapter. However, the main emphasis of the study lies in the argument that an integrated political-technical approach is required for coping with the water conflicts in the Jordan Basin region (see chapter 6.1).

4.1 Supply-side water management options

4.1.1 Fully developing existing resources

In a situation of scarce water availability, management will presumably first try to develop remaining natural resources. Unfortunately, no unused river or groundwater body remains in the Jordan Basin region. But increased catchment of winter flood water anywhere along an already partially used system can also add resources to the water budget. The most important single source not fully developed is the Yarmouk River. Since no storage facility on the river’s main stream has been built so far, an estimated 60-150 mcm/year of the winter floods still flow unused into the Dead Sea via the Lower Jordan (Shuval 1993b: 106). Building a storage system on the main stream of the Yarmouk is one of the measures called for in the Israel-Jordan peace treaty of 1994 (see chapter 5.2). Thus, this option will presumably be realized in the near future.

The option to catch winter run-off can also be applied to smaller wadis. Several such still unused seasonal streams exist on both banks of the Jordan Valley. Each single source would not add huge quantities of water to the budget, but combined they could help to alleviate water scarcity for several local communities. Instead of storing these sources in ponds, collected run-off can also be used to recharge underground aquifers artificially (Assaf 1994). If properly managed, this technique has the advantage of avoiding evaporation, thus also reducing salinization of the remaining water. However, as with all diversions from the Jordan River catchment, these projects will further diminish replenishment of the Dead Sea (see chapter 1.6).

4.1.2 Water Harvesting

Related to the technique just mentioned is the practice of "water harvesting", which consists in constructing small, typically micro-scale dams and trenches to gather and make optimal use of rainfall and storm run-off. The technique was applied by ancient people like the Nabateans to establish rich civilizations in the desert two thousand years ago. Now these practices are being rediscovered and adapted to modern requirements. The basic principle is to collect rainfall over a relatively large area and use it to irrigate just a small portion. However, the technique is only applicable on a large scale in selected places, depending on soil structure and composition. Moreover, the additional water provided will be widely distributed and therefore only available for local use. According to Salameh & Bannayan (1993: 110), if consistently applied, this source will add 30-50 mcm/year or around 5% to the water supply of Jordan. Gains on similar orders of magnitude can be assumed for Israel and the Occupied Palestinian Territories. (See also Schiffler 1993: 64f.).

A special form of water harvesting consists in collecting rainfall from the roofs of houses and storing it in cisterns for domestic use. This practice was widespread throughout the Middle East and Mediterranean region until a few decades ago. It is still in use in some rural areas. Yet in towns and anywhere else where households have been connected to the piped network, it has fallen into disuse. Jordan’s Environmental Action Plan has suggested reviving this technique by requiring house owners to install water-collecting facilities on the roofs of their buildings. Rainfall over a typically 80-m^2 roof in Amman’s popular suburbs would account for 32 cubic meters yearly and would cover 17% of the water consumption of a six-person household (Schiffler 1993: 65). In the Occupied Palestinian Territories, rooftop rainwater harvesting is currently used in 50,000 homes, implying a total harvest of 5 mcm. According to Isaac (1995), if consistently applied, this simple measure could provide an additional 17-25 mcm per year on the West Bank alone. These are not huge quantities of water, but a valuable relief for domestic supply. If stored for use during the summer months, they would be a welcome alternative to the very expensive delivery by water trucks.

4.1.3 Mining fossil water

Below all Middle Eastern countries bordering the Saharo-Arabian deserts extend thick layers of sandstone which in some areas contain large quantities of groundwater. These aquifers are called fossil because they collected at greater depth during earlier geologic ages when other climatic conditions prevailed in the area. At present, they have no recharge rate or only a very low one. Some countries, among them Libya and Saudi Arabia, have already started using these stocks on a large scale (Postel 1993a: 24f.). In Israel and Jordan fossil water is pumped in some areas in the south of the two countries. Some authors have proposed augmenting these extractions as a temporary safeguard against strife (Issar 1994). However, the data basis on the reserves in the Jordan Basin region is uncertain. In general, they seem to be much smaller than in other areas of the

Middle East. For the northern Negev, Issar (1994) concludes that extractions could be increased from 20 mcm/year at present to 50 mcm/year if certain precautions are taken. For Jordan, studies have concluded that some 100-150 mcm/year can be exploited in the south for a period of 50 years, including what has already been tapped (Al-Fataftah & Abu-Taled 1992, p.139). But the greatest problem is that fossil supplies are finite and thus will last only for a limited time anyway.

4.1.4 Cleaning up polluted sources

A better and more long-term oriented option is to save existing renewable sources of water from being spoiled by pollution. A good example for this is the Lower Jordan River. At present, this southern section of the river is not useable at all due to diversion into it of saline sources which otherwise feed Lake Tiberias, and because of its pollution by industrial waste and irrigation run-off (see chapter 1.3.1.2). Cleaning up of the river has been envisaged in the Israeli-Jordan Treaty (see chapter 5.2). In addition to water that both sides will gain through treating saline springs, further quantities of water such as the winter floods of the river will be saved from salinization and thus made available for catchment. This approach may be applied to other sources as well.

4.1.5 Wastewater recycling

After having exploited all remaining natural resources, a supply-oriented water management strategy will go on to develop new resources. A first promising source of unconventional, technology-intensive supply consists in purifying and reusing industrial and domestic wastewater. It is assumed that about 65% of the water consumed by industry and the households can be recycled if collected by sewage systems and properly treated (Assaf et al. 1993: 60). At present, between 20 and 30% of total water consumption in the countries of the Jordan Basin region is attributable to the private and industrial sectors (see Table 2.2). This share is likely to increase rapidly as a consequence of population growth, improvement of living standards, and economic development. Assaf et al. (1993: 60) have estimated that in the year 2023 Israel and Palestinians on the West Bank and in the Gaza will have available some 650 mcm/year and 325 mcm/year of wastewater respectively (the latter figure presupposes, however, that in the future Palestinians will get a substantially larger share of the waters shared with Israel). With similar standards applied to Jordan, the Kingdom will produce some 500 mcm/year of wastewater as well. In sum, these quantities make for more than half of the presently available renewable fresh water sources in the area. Without fully developing these resources, there will be only small quantities of endogenous water for agriculture.

In the Middle East, Israel has been a pioneer in recycling wastewater. At the beginning of the 1990s, 90% of the wastewater in Israel was seweraged, and about 70% was reused, accounting for 195 mcm/year of water, or about 10% of total supply. By the end of the century, recycled wastewater could provide as much as 400 mcm/year (State of

Israel 1992: 60f.). Yet throughout the rest of the region, wastewater reclamation has a great expansion potential. On the West Bank and in the Gaza Strip most cities and all villages still lack a sewerage system to collect wastewater, although such systems are presently under construction in some towns (Sbeih 1994: 341ff.). In Jordan, sewerage systems and treatment plants have been built or are under construction in most towns. However, only a minor part of that is beeing purified. It was expected that treated wastewater reuse would provide about 45 mcm/year of irrigation water by 1995 (Al-Mubarak Al-Weshah 1992: 310). Compared to some 230 mcm/year of water consumed in the domestic and industrial sector, this is an amount which still leaves a great potential to be exploited.

A study based on the Israeli experience indicates that the cost of conveying and treating wastewater effluents amounts to between US$ 0.26 and US$ 0.52 per cubic meter (Ben-Gurion University of the Negev & Tahal Consulting Engineers 1994: 10). Moreover, apart from largely solving environmental problems arising from dumping untreated sewage into natural water bodies or the landscape, recycled wastewater also contributes important nutrients to the soil. Thus, it can obviate addition of commercial fertilizers and organic matter to irrigation water (Sbeih 1994: 345). Taking into account these beneficial side effects, recycled wastewater is one of the least expensive and most attractive unconventional sources of water for agriculture. However, the technique requires high investments and must be applied with caution, since inappropriate use can harm the quality of soils.

4.1.6 Sea water and brackish water desalination

The prospect of desalinating sea water and thus gaining an almost inexhaustible source of fresh water has been intriguing experts for a long time. Desalination is already an important source of supply in Saudi Arabia, the Gulf States, and Malta. Many experts, especially from Israel, have been proposing large-scale use of desalination technology in the Jordan Basin region, too (Kally 1986; Hoffman 1994; Nachmani 1994).

The greatest constraint to widespread use of sea water desalination is its cost. In fact, the technology remains very expensive, making it currently impracticable for most applications. A survey submitted by the Commission of the European Communities (1993: Appendix I) at the multilateral talks on water shows typical product costs between US$ 1 to US$ 1.7 per cubic meter, depending on process techniques and scale of application. Some Israeli companies active in the business have been offering plants on the drawing board which are supposed to desalinate sea water at product water costs of US$ 0.65 to 0.70 per cubic meter (Hoffman 1994). However, product costs of the plant do not include expenses for water storage and transport from plant to consumer. Thus, even if these relatively low figures are accepted as realistic, total water cost for the consumer would probably amount to at least around US$ 1.

These costs must be put in relation to the product output per cubic meter of water used in agriculture, which is the greatest consumer in the Middle East (see chapter 2.1 and

2.4.1). According to Fishelson (1994: 428f.), the volume of water consumed per US$ of agricultural output in Israel is about 0.75 cubic meters. Conversely, this means that the average value output per cubic meter of used water is about US$ 1.3. Consequently, should desalinated sea water be used for irrigation, the value of the yields would just about cover the cost of the water. All remaining labor, investment, and operation costs, including the cost of irrigation facilities, would have to be subsidized. These estimates are confirmed by Kally (as quoted in Assaf et al. 1993: 56) who states that "the maximum water cost that can be borne by agriculture is about US$ 0.25 per cubic meter which is the maximum product value for water for most irrigated crops grown under normal modern agricultural techniques".

In this context, one has to consider that the Israeli agricultural sector is one of the most highly developed and water-efficient in the world. In the neighboring Arab countries and in the Occupied Palestinian Territories the account in using desalinated sea water would turn out even much worse (see also Kally & Fishelson 1993: 29). In Jordan, moreover, large-scale sea water desalination has no practicable path, since the only shoreline of the country is at Aqaba on the Dead Sea, far away from the population and production centers. Judging from these facts, sea water desalination is currently a practicable option only in very exceptional cases, *e.g.* for domestic or industrial consumption in areas with no other fresh-water sources available, or for economic activities like tourism with inelastic water demand in relation to price.

More convenient and thus more realistic in the short term is desalination of brackish water. This is water with an amount of total solved solids between 1,000 and 5,000 mg per liter, more than affordable for drinking and irrigating, but much less than the 35,000 mg contained in sea water. Such water is relatively widespread in the region, either for natural reasons or because of increasing salinization of fresh supplies. The abovementioned study by the Ben-Gurion University and TAHAL (1994: 12) assumes expenses of US$ 0.25 to 0.40 for treating brackish water, which is three to four times less than sea water desalination, and comparable to the cost of wastewater treatment.

4.1.7 Water imports

Among the most popular proposals on the supply side is the idea of importing water to the Jordan Basin region from other areas in the Middle East possessing a water surplus. One of the countries envisaged as a water supplier is Turkey. In 1987, former president Turgut Özal suggested the bold concept of a "Peace Pipeline" to supply water to its southern neighbors. Water should be taken from two rivers, the Seyhan and the Ceyhan, that presently empty unused into the Mediterranean Sea, and transported in two pipes of several thousand kilometers each. The western line would pump 1,300 mcm/year of water to Syria, Jordan, western Saudi Arabia, and possibly Israel. The eastern pipe would carry water to the Persian Gulf through Kuwait, eastern Saudi Arabia, Oman, and the Emirates. The two pipelines together would cost US$ 21 billion (in 1990). A more modest "mini-pipeline" has also been proposed (though not by Turkish officials) to supply water to Syria, Jordan, and the West Bank. It would have a capacity of 600-700 mcm/year and cost perhaps US$ 5 billion (Brooks & Lonergan 1993: 102).

However, these proposals never found serious advocacy in the political arena. The first open question is that of financing and final costs. Assuming that the very roughly assessed costs of US$ 21 billion are correct, this would imply investment costs of nearly US$ 10 per cubic meter of yearly transported water. If one assumes interest rates between 6 and 12% this would result in US$ 0.6 to 1.2 for investment costs alone. Adding operation and maintenance costs, and the price to be paid to the original owner of the water, total costs will presumably result to be even much higher than sea water desalination. Moreover, a number of political problems make realization of such an undertaking very unlikely. The Arab States view Turkey's attempts to become a water broker for the region with suspicion. Syria and Iraq are already engaged in a water dispute with Turkey over the Euphrates and Tigris rivers. It is hardly conceivable that they will agree to a project which means having to pay for water that they feel is being kept from them illegally. Israel, on the other hand, is not willing to become dependent on a water source which would have to cross many other states and could be cut off at any time by a potentially hostile neighbor, such as Syria.

More realistic options from an economic and technical point of view are plans to convey water from Egypt through a 40-km prolongation of the existing Nile-Sinai Canal up to Israel and the Gaza Strip, or from Lebanon by diverting the waters of the Litani into the Upper Jordan River. Kally (1993: 187) calculates product costs of US$ 0.38 and 0.11 respectively for the conveyance of 100 mcm/year each, at 6% interest rates. However, these proposals also pose a series of political problems. For example, countries upstream of Egypt may have a legal say in any transfer of Nile water (Wolf 1995: 92). And although the envisaged amount of 100 mcm/year would make up for only 0.2% of Egypt's annual water consumption, deliveries to another state may cause public upheaval in a country itself affected by severe water scarcity. Water deliveries from the Litani, on the other hand, are only conceivable in a context of full peace at Israel's northern border. And even then, the wounds and bitterness left behind by more than a decade of military occupation and repeated Israeli incursions, as well as the Lebanese water needs themselves, will not make any deal easy to accomplish (see also chapter 3.3).

A variant of importing water by pipelines and canals is the idea of transporting it by sea, either in converted oil-tankers or in so-called "Medusa-bags". The latter option refers to a technology developed by a Canadian company involving huge bags made of thick nylon coated with vinyl. Each of them should carry up to 3.5 mcm of water and be towed by tugs on the sea. Again, a Turkish river, the Manavgat has been envisaged as the potential supplier of water. According to a feasibility study by Israel's water planning corporation Tahal, capital and operating costs for a system with the capability of delivering 250 mcm/year of water would be considerably lower than transport by pipelines, canals, or tankers. The price of US$ 0.17 to 0.23 per cubic meter (in 1989) would even be competitive with some conventional sources. Also political implications are supposed to be lower, since the deal would involve only two parties and not foresee transit through third countries. However, some technical uncertainties remain - uncertainties that, Tahal warns, could increase costs considerably (quoted from Brooks & Lonergan 1993: 100).

4.1.8 Canals from the oceans to the Dead Sea

A combination of water imports from other basins and sea water desalination is represented by the project to convey sea water from the Mediterranean or the Red Sea to the Dead Sea via a tunnel and/or canal system. Originally, these plans were conceived as a means of generating hydropower by taking advantage of the 400 meter difference in elevation between the oceans and the Dead Sea. A further goal was to replace the water losses in the Dead Sea due to diversions along the Jordan and Yarmouk rivers (see chapter 1.6). Those plans have now been reconceived so that part of the electricity generated would be devoted to desalinating sea water and thus gaining new fresh-water supplies (Glueckstern & Fishelson 1992; Murakami & Musiake 1994; Murakami 1995). A feasibility study commissioned in connection with the multilateral talks is underway (*Israel Line*, 13 March 1994 and 16 December 1994). The option which seems more likely at the moment is the realization of the Red Sea-Dead Sea Canal which could become a focal point of Israeli-Jordanian cooperation after the Peace Treaty of October 1994.

However, the Red-Med Canal is a US$ 3-billion mega-project of uncertain economic viability and possibly adverse environmental effects. Estimates of product water costs range from US$ 1 to 2 per cubic meter according to Wolf (1995: 255). Another study by Murakami & Musiake (1994: 143) cites costs of US$ 0.68 per cubic meter of water (at price level of 1990) for a plant producing 100 mcm annually, not counting distribution expenses. This gives the same reasons for skepticism as in the case of simple sea water desalination plants. These prices may only be affordable if the water is primarily used to supply tourism facilities on the shores of the Dead Sea and eventually for some very sophisticated agro-industrial complexes, but not for conventional agriculture.

As regards environmental effects, the main problem is that the balance between water inflows into the Dead Sea and evaporation from its surface is a very complex matter. Among other things, it depends on the salinity of the water, and on possible macro- and microclimatic changes, possibly even induced by the artificial input of sea water. Such a balance is therefore not easy to achieve and much less to foresee. Miscalculations and unexpected effects might result in flooding a greater area than originally planned or require decreasing sea water input, inevitably jeopardizing the project’s economical viability. Moreover, studies prepared by Jordanian hydrologists in the 1980s warned that even stabilization of the Dead Sea water table at the planned level of -390 meters below sea level would increase salinity in the nearby fresh water aquifers, submerge several inhabited centers, roads as well as tourist establishments, and affect the potash extraction works in the southern part of the lake. Increased pressure on the Dead Sea bottom by the greater volume of the lake might also increase the likelihood of earthquakes and volcanic eruptions in this area very prone to tectonic activities (Hamadneh 1985: 47; also Salameh 1985).

4.2 Demand-side water management options

Supply-oriented management is the classical approach to coping with water scarcity. Fresh water being an existential and not substitutable resource, one might be tempted to regard this as the only feasible option. Yet, the assumed inelastic nature of water demand is only true with respect to the strictly life-sustaining use of this resource in private households. Even here, different standards of consumption are possible. Beyond the 100 or so liters of water per person a day needed for drinking, cooking and sanitation, water use is not an end in itself but a commodity aimed at satisfying particular social and economic end uses or services; *e.g.* growing a certain amount of agricultural crops, cooling a certain amount of material, or assuring a high comfort and standard of living (see chapter 2.1). From this perspective, the question becomes how each of these end-uses or services can be most efficiently satisfied, and, in the case of preference conflicts, which demands are to be favored.

Demand management can take many forms, from precautions to diminish losses, to technical measures to improve the efficiency of water use at the system level or at the user end, to measures to control and/or reallocate water consumption among sectors of utilization. In terms of policies, measures can be direct, aimed at prescribing and/or rationing water allotments by administrative orders; or indirect, to influence voluntary behavior through market mechanisms, financial incentives, or public awareness programs. Demand-side management also encompasses the institutional arrangements supervising the water sector, which often have a considerable influence on allocations and consumption patterns (Berkoff 1994: 31f.).

Supply- and demand-oriented instruments, however, should not be played off against each other. Within both sets of measures we find some more and some less economically and environmentally sound instruments. Realistically, a water management plan for the Jordan Basin region will have to rely on both supply- and demand-oriented measures.

4.2.1 Water conservation in municipal and domestic uses

Municipal use of water includes a great variety of end uses, such as fighting fires, cleaning, irrigating parks, public swimming pools, and supplying households and businesses. Opportunities for conservation and use of recycled water at the user level are evident. However, the first aspect of the municipal system to be addressed is the system itself: reducing pressure, valve maintenance, and, above all, repair of leaks. Unfortunately, the latter problem is widespread in the Middle East. In Jordan and the

Occupied Palestinian Territories, losses in the municipal networks amount to 55% of the carried water due to leaks in pipes and careless operation (Beschorner 1992: 16; Center for Engineering and Planning Ramallah 1994: 23). Even in Israeli cities water losses of 10 to 15% are quite common, with peaks up to 30% (Brooks & Lonergan 1993: 55). Identification and repair of leaks in the water distribution system is expensive and requires an efficiently organized administration. But generally it is one of the most immediate and cost-effective ways of decreasing water demand.

At the user end, water demand in the domestic sector tends to be less elastic than other uses, partly because this demand is essential for life and well-being, and partly because (except for the poorest people in developing countries) water does not account for a very large part of household budgets. Nevertheless, great potential for saving exists, especially in Israel, where domestic consumption reaches western levels, and among the higher social classes in Jordan who are adopting similar habits. The major uses for water in housing with internal plumbing are flushing toilet, washing clothes, and taking showers/baths. Significant overall gains are attainable from simple technologies and minor changes in habits. For example, low-flow household faucets and shower heads can cut use by 50% and more on the single tap. The same applies to low- and variable-flow toilets. If hot water is saved, the gains are multiplied: energy as well as water. Examples from several cities in the world show that even small conservation programs can reduce residential per capita uses by 10 to 30% within a few years (Postel 1992: 146ff.). Investment costs are relatively low and typically have very short paybacks periods of a year or even less.

In this frame, a longer-term task is to adjust structural failures from misplaced incentives in the housing sector. Firms or agencies building housing units in general do not continue to own or manage them. Given market and political pressures to build at low unit cost, they are not likely to include water-saving plumbing if it is more expensive. Therefore, housing is the sector where regulations for minimum efficiency standards in water-using equipment are most appropriate (Brooks & Lonergan 1993: 53).

Another possibility of saving high-quality fresh water in the residential sector is the installation of dual distribution systems. Much water from the normal network is presently used for purposes such as cleaning, fire hydrants, or garden watering, which do not require the same quality standards as for drinking and cooking. For these uses, brackish water and in some cases even sea water may be considered if a dual distribution system is constructed. However, installation of such an infrastructure takes considerable time and implies great investments as well as high maintenance costs. Investigations are needed to assess the economic viability of such systems on a large scale.

For those housing units with external space, lawn and garden watering, as well as private swimming pools typically make up the bulk of residential water uses. These latter end uses, however, are more responsive to price than other domestic uses (Brooks

& Lonergan 1993: 53). Thus, progressive water charges for those uses exceeding the minimum requirement of 100 liters per person and day might provide the right incentives to change habits and/or take measures to recycle water within the households.

4.2.2 Water conservation in commercial and industrial uses

Commercial and industrial water uses in the Jordan Basin region are relatively low, adding up to 5-7% of total water consumption (see Table 2.2). But their importance is growing. For most commercial uses of water in the tertiary sector, *e.g.* the hospitality industry, much of the technologies appropriate for residences are equally applicable, and others, such as self-closing valves, can be added. A Swiss company, marketing water-saving sanitary equipment, typically obtained savings of 30% and more by installing taps and shower heads which blend air into the water, and automatic flow-variable toilet flushes in the rooms of hotels and lavatories of restaurants. These systems had a payback within a few months, sometimes even within weeks. It is difficult to estimate what the savings might be in Middle East countries, since the starting point is different from Western Europe. But casual observations by the author indicate that there is a great and mostly undeveloped potential.

Generally, strictly industrial uses are among those cases in which water saving potentials are the greatest (Postel 1992: 32f.). Since industrial water is usually polluted rather than consumed, this allows a factory to recycle its own supplies, thereby getting more output from each entity of the water used. Yet countries in the Jordan Basin region have already exploited a great part of the margins for improvement of industrial water-efficiency. A report on water management in Jordan by the German Development Institute (Schiffler et al. 1994: II) concludes that even an increase of water tariffs would not give great incentives for further savings because Jordanian industry has already undertaken substantial efforts to save water. Water use per unit of product in Jordan is lower than in the highly modernized economies of Germany or Japan, even though water charges in Jordan are relatively low. Water saving was induced here not by price incentives but by objective physical lack of water and by improved regulations on wastewater quality standards. These latter measures induced many companies to choose processes incorporating reuse or recycling of their water (Schiffler et al. 1994: 25).

Israeli industry also already seems to have comparatively high water-efficiency standards (Brooks & Lonergan 1993: 54). Thus future industrial water demand in the Jordan Basin region is likely to increase in proportion to productive output. Nevertheless, price regulations might give the right incentives to optimize water efficiency further. Industry is the sector with the highest value output per water unit consumed. It therefore seems to be that branch which could best afford water price increases without being unduly affected in its overall productivity and competitiveness (see also chapter 2.4.2).

4.2.3 Improving irrigation efficiency

Since 65-70% of water in the Jordan Basin region is used in agriculture, this is where conservation measures will have the greatest impact in absolute terms. As in the municipal sector one must discern water conservation at the network and end-user level. Intervention at the farm level offers the largest saving potential, although improvement in overall distribution systems may also help saving considerable amounts of water.

Table 4.1
Water efficiency of different irrigation techniques

Surface irrigation	*40-70 %*
Sprinkler irrigation	*60-85 %*
Drip irrigation	*70-95 %*

The relatively wide range within individual techniques is due to the fact that efficiency depends on the crop, as well as on topographical and soil structure. Source: Schiffler, Manuel et al. (1994): Water Demand Management in an Arid Country. The Case of Jordan with Special Reference to Industry. Reports and Working Papers of the German Development Institute No. 10. Berlin

At the end-user level, water efficiency depends on the irrigation techniques applied. Modern sprinkler and micro-irrigation techniques have a saving potential on the order of 50 to 100% compared to traditional surface irrigation methods. Among the best-known micro-irrigation techniques is drip irrigation by which relatively small quantities of water are delivered directly to the roots of growing plants by means of perforated plastic piping. Because only a fraction of the soil is watered, water savings are substantial. When fully developed, so that water flow is controlled by sensors linked to central computers, this technique approaches an efficiency of 100%. Micro-irrigation techniques have the further advantage of reducing adverse environmental impacts typical of land under continuous irrigation. Notably, they can avoid or reduce salinization of soils. Also, unlike surface irrigation, micro-irrigation techniques do not produce drainage returns which often affect the quality of nearby rivers or aquifers. On the other hand, micro-irrigation methods require previous water treatment such as filtration and mixing with fertilizer, pressurized pipes, and a reliable water supply. Thus they are not a cheap technique. Initial outlay typically amounts to some US$ 1,500-3,000 per hectare. Moreover, the system must be run by specialized personnel and requires continuous maintenance (Postel 1993a: 28ff.; van Tuijl 1993).

Yet these techniques are already widely applied in the Jordan Basin region. Israel has been the pioneer in developing water-saving irrigation technologies. Modern techniques are applied today on the whole irrigated area, and half of it is under drip (note that drip-irrigation is not applicable everywhere, and sprinkler irrigation performs better for some crops). The efforts to increase the efficiency of agricultural water use at the farm level have been highly successful. Total irrigation water consumption reached a peak of

1,434 mcm in 1985-1986 and is slowly sinking since then (1993: 1,112 mcm), although agricultural output has continued to increase both in product quantity and value. Water consumption per hectare has declined from nearly 6,400 cubic meters per hectare in 1975 to 4,500 in the late 1980s (Kliot 1994: 241). Over the same period of time the volume of water consumed per US$ of agricultural output has declined by half, from 1.53 to 0.75 cubic meters (Fishelson 1994: 428f.).

In Jordan too, sprinkler and micro-irrigation techniques are not unknown methods. At the beginning of the 1990s, in 86% of the irrigated area modern irrigation techniques (sprinkler or drip) were applied (van Tuijl 1993: 7 and 14; The Kingdom of Jordan 1992: 23ff.). Water efficiency of Jordanian farms was estimated at 76% on the average by Schiffler (Schiffler 1993: 19). This is quite a good performance, which leaves small margins for further improvement. A greater potential for expansion exists on the West Bank, although at present application remains limited to small parcels of land due to the extreme lack of agricultural water.

Although water efficiency at the single farm can be generally regarded as satisfying, a greater field of conservation potentials is offered by systems feeding the single farmers. In irrigation schemes where water is pumped or diverted from nearby sources waste is usually low. But where water has to be stored and/or transported for long distances, losses can be very high. In open systems evaporation causes considerable losses which could be avoided by using closed pipes and/or storing water in natural underground aquifers. Moreover, as with municipal supply, careless and improperly maintained schemes can cause great waste.

In Jordan, 26% of irrigated land is still fed with open surface canals, above all the northern section of the King Abdullah Canal. After more than 30 years of operation, the condition of this network has markedly deteriorated and its conveyance efficiency averages only 60%. That means that 40% of the water carried is lost before reaching the farms. Moreover, farms fed by open conduits are more reluctant to introduce modern drip-irrigation systems, since they need further investment to pressurize the water. In the southern section of the King Abdullah Canal, which consists of pressurized pipes, losses still amount to 15% due to leaks in the conduits and improperly operated sluices and valves. Therefore, while Jordan’s water efficiency is fairly high at the farm level (75%, see above), the combined efficiency of water conveyance and farm irrigation is only 55% (Schiffler 1993: 18f.; The Kingdom of Jordan 1992: 30ff.). Thus investments in modern conduit infrastructure, better monitoring and maintenance, and the synergy effects these would produce at the farm level would help to save considerable quantities of water.

Another form of improving agricultural water efficiency is development of species with a greater output per water unit or of salt-tolerant crops. Citrus trees, for example, cannot tolerate briny water at all, while olive, fig, and date trees can. Broccoli, tomatoes, spinach, beets and other vegetables also tolerate a certain degree of salinity (Brooks & Lonergan 1993: 33). Salt tolerance can be improved by selecting seeds and crossing species, as has been done to optimize other characteristics of crops since time immemorial. Brackish water is used in Israel to irrigate certain crops, and on an experimental level tomatoes have even been grown with sea water. However, irrigating with saline water affects the soil and must therefore be practiced very cautiously.

4.2.4 Water re-allocation among uses and sectors

The greatest potential for reducing water demand is probably given by reallocation of water among uses and sectors of consumption. While water *conservation* concentrates its efforts on optimizing efficiency without questioning the uses themselves, *reallocation* means shifting water allotment from those uses and sectors which show a low value added per unit of water consumed to those of primary social need or with higher water productivity. In other words, this approach calls for restructuring economy away from heavily irrigated agriculture towards other sectors, in particular domestic consumption (because of population growth), as well as industry and commercial uses. Within the agricultural sector, irrigation should be shifted away from particularly water-intensive crops (*e.g.* cotton, bananas, and wheat), and kept up for those plantations with greater product and value output per water, *i.e.* vegetables and certain kinds of fruits (see also chapter 2.1). Where possible, irrigated cultivation might be converted back into rain-fed farming. The inevitable decrease of agricultural output and the disappearance of some crops from domestic production should be replaced by imports.

If one takes into account the real weight of agriculture for the overall economy, resizing this sector in at least some of the countries concerned, appears less unthinkable than at first assumed. In Israel, despite an impressive absolute increase, the relative contribution of agricultural production to the GNP declined from around 11 to 3.5% between 1950 and 1993, while the proportion of agricultural exports decreased from 60 to 2.4% of the total. Today, export of products from the machinery industry, polished diamonds, and chemicals exceeds agricultural exports by many times. Agriculture makes up for just 4% of total employment (Statistical Abstracts of Israel 1994, as reported by *Israel Information Gopher*). Compared to these figures, the 65% of water allocated to irrigation seem quite disproportionate. This evidence is accentuated if one takes into account that value added per unit of water consumed in the commercial and industrial sector is 30 to 40 times higher than in agriculture (see also chapter 2.4.2).

From this perspective, the common view of Israel as a model of sound water management does not entirely correspond to reality. It is true that the country has done quite well in micro-level choices to ensure that water is consumed efficiently at the point of use, especially in agriculture. But it has done much less well in macro-level decisions that allocate water among alternative uses and users (Brooks & Lonergan 1993: 8). As subsidized water is often used for export crops, the benefit is effectively passed on to foreign consumers. Thus Baskin (as quoted in Brooks & Lonergan 1993: 44) states ironically that it would be cheaper to import oranges from Europe than to grow them in Israel.

Gideon Fishelson, an economist from Tel Aviv University, modeled a scenario in which agricultural water consumption in Israel would be gradually decreased from about 1,100 mcm/year at present to half of that, or 555 mcm/year. He concludes that "cutting the quantities of water is feasible and seems to be economically of relatively low cost" (Fishelson 1994: 438). The water saved could be used to satisfy domestic and industrial demands, which are expected to increase by yearly 50 mcm in the next future. Similarly a group of 'liberal' Israeli economists including Fishelson argue that agricultural production - aa well as the water needed for it - should be gradually shifted to the West Bank and Gaza Strip because of a number of objective factoral advantages, above all cheaper labor force (Eckstein et al. 1995). However, Fishelson remembers that such purely economic calculations do not take into consideration the social, political, and environmental costs that the decreasing of agricultural surface and production may cause (Fishelson 1994: 438).

The situation is somewhat different in neighboring Arab states and the Occupied and Autonomous Palestinian Territories. Jordan, for example, is no longer an agrarian society, as one might possibly assume. In fact, the country has a high level of urbanization (70%), and the agriculture’s contribution to the GNP is only 7%. Somewhat higher is the agriculture’s share of total labor force and exports (both 10%; see Table 2.6). On the other hand, Jordan’s overall economic indicators are far less promising than Israel’s. Its GNP is covered to a considerable extent by foreign aid and the transfers of Jordanian migrants working abroad. 25% of the labor force is unemployed, and public resources to finance economic restructuration are limited. Nevertheless, some long-term adjustments aimed at gradually reducing irrigated agriculture and promoting water-saving industrial and commercial activities seem inevitable (Schiffler 1993: 77).

From this point of view, the situation of the Palestinians in the Occupied Territories is even more difficult. Agriculture accounts for more than one quarter of the GNP and total employment, and 10% of total exports. In view of the great lack of job opportunities, the very precarious social and economic conditions, and the fact that a great potential of irrigable land on the West Bank is underdeveloped, a resizing of the agrarian sector seems unfeasible in the immediate future. Rather, as suggested by the Israeli economists cited above, some improvements in water supply to Palestinian agriculture might be necessary and economically appropriate in the middle term. However, the long-term development programs in the Occupied Palestinian Territories should not put their emphasis on the agrarian sector. Light industry and handicrafts as well as services will provide more jobs and consume much less of the scarce water per unit of revenue than agriculture.

4.2.5 Water pricing

Taken all together, the many ways of conserving, recycling, and reallocating water resources constitute the makings of an efficiency revolution. Yet these changes need to be induced by incentives capable of consistently enforcing water-saving measures on both the micro- and macro-level. There is a consensus among experts that price mechanisms have to play a central role in managing water demand and stimulating development of affordable sources of additional supply. As in many other places of the world, a great part of water wastes and misallocations in the Jordan Basin region stem from the failure to value water at anything close to its true worth. Grossly underpricing water perpetuates the illusion of the people that it is still plentiful and makes it uneconomic to apply water-saving measures. On the macro-economic level, it favors misallocation (Postel 1992: 165f.).

Again, anomalies are greatest in the agricultural sector. In all the countries of the Jordan Basin region, irrigation water prices are heavily subsidized. Especially Jordan has a weak water pricing policy, quite complicated, varying from region to region and from sector to sector. In the Jordan Valley, farmers were required to pay only US$ 0.01 per cubic meter at the beginning of the 1990s. These tariffs were supposed to be doubled as of October 1994, yet still remaining far behind real production and conveyance costs of about US$ 0.09 per cubic meter (0.06 capital costs plus 0.03 for operation and maintenance). Water pricing is not used at all as a specific means of demand management (Schiffler 1993: 31ff.). These extremely low tariffs are not justified by the socioeconomic situation of the farmers. Usually, farms are modernly equipped, highly productive, and quite prosperous. The high subsidies to the Jordanian farmers are rather an expression of preferential treatment to landowners which represent an important pillar of the political power in Jordan (Renger 1995). Admittedly, due to the physical scarcity of water, these low prices have not affected its relatively efficient use at the farm level. But higher charges would at least give the water authority the funds needed to appropriately monitor and modernize the networks, thus enabling it to reduce the high water losses which presently occur at the system level (see also chapter 4.2.3).

Israel is no exception when it comes to subsidizing agricultural water, although it does not go to the same lengths as most of its neighboring states. Since the mid-1970s, the country has adopted a progressive water-pricing system aimed at discouraging overdraft of the allocations. But at the beginning of the 1990s, the charges of US$ 0.15 per cubic meter (for the first 70% of the allocation quota) covered only about 40% of operation and maintenance costs (van Tuijl 1993: 40; Elmusa 1993, footnote 28 on p. 75). Subsidizing irrigation water in Israel is related to the dominant role given to agriculture in Zionist ideology, and later in Israel's security thought (Lowi & Rothman 1993: 165). At the institutional level, this dominant role of the agricultural sector led the Water Commissioner, which is the central water planning authority, to become part of the Ministry of Agriculture. Experts have therefore demanded removing the Water Commission from the Ministry's authority and giving it the independence, status, and structure to design and implement a more sectorally neutral water system (Brooks & Lonergan 1993: 36f. and 112).

In the Occupied Palestinian Territories, water taxes charged by the Israeli administration have been very high and discriminatory (see chapter 3.4.1). Along with the constitution of a Palestinian water administration of their own, the primary tasks advocated by Palestinian experts themselves seem to be introducing graduated charges for both domestic and agricultural use, and establishing an effective fee collection system (Center for Engineering and Planning Ramallah 1994: 23ff. and 55). However, the danger is that, due to administrative inefficiency and/or short-sighted measures to gain public support, these steps might not be taken with enough determination.

4.2.6 Regional water allocation through trade in markets for water rights

As an extrapolation of water-pricing mechanisms onto the international level and considering some of the inter-basin water conveyance options, authors have proposed to establish markets for water rights as a means of optimizing regional water allocations (*e.g.* Schechter 1994). In such an open market, countries with water surpluses would be willing to trade water rights with shortfall countries, in an arrangement fairly valuing water like any other commodity. The outcome would be the allocation of water to those consumers which make most productive use of it, while the others would receive monetary or other compensations. This would increase overall use efficiency, and - at least in theory - improve the welfare of each participating party.

However, apart from the social distortions which inevitably result from totally open markets, the proposal best illustrates the dependence of technical cooperation on previous settlement over distribution of water quotas. It is through ignorance that markets for water rights are sometimes referred to as a means of solving water disputes by providing mechanisms to "share" or "distribute" water resources. In reality, market mechanisms are all but a means of clarifying property rights. On the contrary, to work properly initial property rights must be previously clarified. Only in such a setting, can economic decisionmakers meet in a market and freely trade products and commodities. In the case of transboundary water resources, the needed clarification can only be provided by political means, *i.e.*,: by an agreement over mutual water rights.

4.2.7 Last but not least: halting population growth

Speaking about demand management, one should not forget the currently most important drive to increase demand: demography. Population growth rates in the Middle East are among the highest in the world, and the Jordan Basin region is no exception to that. While the Arab countries in general show growth rates of more than 3% due mainly to a high fertility (but due also to refugee influx as a consequence of political events). Israel has been compensating for its lower natality by an active policy of promoting immigration of Jews from all over the world. In the 1990s, mainly due to the influx of hundreds of thousands of Jews from the former Soviet Union, Israel boasted a growth rate of 2.6% (see also Table 2.1).

A growing population affects the domestic demand in direct proportion, as well as indirectly, by increasing demand for goods and services, the demand by the other sectors. Any of the policies of water management discussed will only delay the moment of collapse, if population continues to grow. Dealing with family planning and immigration control as a means to limiting water demand touches a series of complex socioeconomic, cultural, and ethic domains which go beyond the purposes of this paper. Unfortunately, demographic patterns and policies in the Jordan Basin region are also very intimately linked to the very political roots of the Arab-Israeli conflict. In competing over land, Arabs and Jews always saw the demographic balance between each other in terms of national security and existence. Gaining (or keeping) the demographic majority on the territory of historical Palestine is still seen, by both sides, as a means to enforce own political claims. Thus the result are policies to promote natality and/or immigration.

Such circumstances complicate the discussion of demographic issues from a pure environmental carrying capacity view. It seems that rational discussion and implementation of family planning and immigration control measures will only be possible within the context of a political settlement fixing Israel’s definitive borders and giving the Palestinians their own independent national home. Only then will demography lose its function as a 'weapon'. The Palestinian state will have a vested interest in introducing family planning measures, if it wants to preserve its chances for sustainable and balanced socioeconomic development. And the Israelis will have to accept that the extension and supportive capacity of their land is limited. Thus an active immigration policy, especially when it concerns Jews who are not pursued, will clash with their vested interests.

Yet peace itself will inevitably lead to population growth in the Jordan Basin region, at least in the short term. This is because it is expected that in a peace agreement at least part of the Palestinian refugees from the 1948 and 1967 wars, living today in camps in neighboring countries, will receive a right to settle in the new Palestinian political entity. This is a major claim of the Palestinian side, and the Declaration of Principles of 1993 between Israel and the PLO (Art. V.3) provides that it will be negotiated in the frame of the permanent solution for the territories. Nobody knows how many out of the about 1.7 million registered Palestinian refugees will be allowed to resettle, and how many of them will actually do so. However, the discussion is on the order of some hundreds of thousands.

Water-wise - as in other respects - the refugee question represents a dilemma which knows no perfect solution and will therefore require compromises. Resettlement of Palestinian refugees - like their eventual definitive integration into the host states - will inevitably increase pressure on the scarce resources. On the other hand, a settlement of the refugee question is an imperative for reaching an overall agreement. The latter, in turn, is a necessary condition for enabling regional cooperation in the field of water management, and a prerequisite for introducing effective family planning programs and changes in immigration policies (see above). The demographic question shows once again how water problems in the Jordan Basin region are intrinsically interwoven with the political core issues of the Arab-Israeli conflict. Any policy which addresses these issues in an isolated manner is therefore doomed to fail.

5 Towards Resolution? - Water Diplomacy in the Current Middle East Peace Process

While the water crisis itself is a consequence of natural scarcity and growing demand, *water disputes* in the Jordan Basin region stem from the lack of binding legal agreements regulating the use of shared water bodies. The approach to cope with this properly *political* dimension of water conflicts is water diplomacy, understood as "the skill of equitably distributing transboundary water resources" (Schiffler 1995: 14). This chapter will first review principles of international law in distributing shared hydrological resources. Diplomatic successes achieved so far in the current Middle East peace process will then be analyzed with respect to water. As in chapter 3 which outlined the conflict, the different bilateral trails of the negotiations will be treated separately. However, due to lack of substantial results so far, the Israeli-Syrian and Israeli-Lebanese negotiations will not be pursued further. The last section of the chapter deals with the working groups on water and environment within the frame of the peace process's multilateral track.

5.1 Principles of international water law

As briefly outlined in chapter 3.1.1, past attempts to achieve a binding water distribution regime in the Jordan Basin region have been impeded by deep political differences between the riparians. Actually, achievement of an agreement is also complicated by the fact that no general legal rule of binding character exists which regulates the non-navigational use of shared waters. Traditional principles of international law relating to the concept of sovereign nation states have proven unable to cope with the problem of sharing transboundary waters. On the contrary, by supporting opposing positions, they tend to fuel disputes in international basins rather than to settle them. Countries upstream, asserting their right to absolute *territorial sovereignty*, feel entitled to do whatever they want with rivers and groundwater flowing through their territory (so-called Harmon Doctrine). On the other hand, countries downriver can assert their right to *territorial integrity* and insist on unaltered flow, both in terms of quantity and quality. Thus international river and aquifer systems are the most evident example of the general contradiction between historically grown political boundaries of sovereign states and natural borders of eco-geographical regions.

In the last few decades, however, a broad system of principles and practices has evolved, resulting in a high number of bilateral and multilateral treaties in many international river basins around the world. By 1990, more than 280 international treaties dealing with transboundary water issues had been signed (Frey 1993: 58). Based on them, international organizations and other institutions have attempted to derive more general principles and new concepts governing shared fresh-water resources. The work of the International Law Association (ILA), a private organization, and the International Law Commission (ILC) of the United Nations are among the most important and authoritative examples. Despite not being legally binding on states, the "Helsinki Rules on the Uses of the Waters of International Rivers" of 1966 codified by the ILA and the "Law of the Non-Navigational Uses of International Watercourses" drafted by the ILC in 1991 are generally accepted as part of customary international law (Caponera 1992; Kliot 1994).

The main rule referred to in both agreements is the principle of "equitable utilization" and "reasonable and equitable share" in the beneficial uses of the water in an international drainage basin. This doctrine states the concept of a "drainage basin" as a unit, and requires the interests of all riparian countries to be taken into account when allocating and using its waters. However, 'equitable' does not mean *equal* use. Rather, it is quite a flexible principle based on consideration of a wide range of elements, including:

- *natural factors* such as climate, hydrological origin of the water, and share of each riparian in the basin's drainage area;
- *social and economic needs* of the water course states concerned;
- *effects of use* of the water course in one riparian state on the others;
- relative *dependency* of each state on the shared waters and the availability of alternatives;
- existing and potential uses, including in particular the *right of prior use*;
- *efficiency criteria* such as avoidance of unnecessary waste in using the waters of the basin.

(This compilation considers both the "Helsinki Rules" of the ILA and the "Law of the Non-Navigational Uses of International Watercourses" by the ILC. Both agreements are documented in Kliot 1994: 277ff.)

Other rules considered fundamental, though in part implied in the principle of equitable utilization, are the obligation not to cause appreciable harm to other states; the obligation to notify, inform and share data; and the duty to cooperate in managing international water courses and resolving disputes peacefully. These doctrines have evolved mainly over surface water issues, but today it is accepted that they generally cover transboundary groundwater as well (Barberis 1991).

Although the theory of "equitable share" overcomes the two extreme doctrines of absolute territorial sovereignty and integrity, it does not provide a patent remedy to all water disputes. The mentioned factors to be considered in defining 'equity' remain in part conflicting, and the agreements do not state relative weights or priorities among them. Interesting attempts have been made by academics to operationalize the concept, either by fixing equal minimal requirements for each inhabitant of the basin concerned (Shuval 1993a), by calculating nature's own apportionment (Isaac & Zarour 1993), or by combining several of the mentioned criteria into mathematical formulas (Moore 1994; Dombrowsky 1995: 133ff.). In the practice of negotiations, however, even these detailed operationalizations can only serve as guidelines to which arrangements should orient themselves and with which they should be compatible. This is underlined by the fact that there is no supra-national authority which can compel unwilling members of the international community to abide by such rules. Moreover, hydrological complexities and different sociopolitical context in each basin preclude application of sweeping legal generalities. Theoretically, arbitration by the International Court of Justice can be demanded, but this requires previous consent of all parties involved (Wolf 1995: 99).

In the final analysis, the principle of "equitable utilization" is rather a negative criterion, important to ascertain cases of evident unequitable allocation, and to refer to in negotiating redistribution. Present allocations in the Jordan Basin region violate both the word and spirit of the "Helsinki Rules". This applies both to Israel’s virtual monopoly on the waters of the Upper Jordan (which has been partially overcome through the Israel-Jordan peace treaty; see chapter 5.2); and to the greatly asymmetric distribution of the West Bank Aquifer between Israel and the Palestinians. In both cases, a single factor out of the series of elements making up "equity", namely the right of prior use, is set as absolute. Moreover, Israel can only in part legitimately call upon the principle of prior use, since physical control over some of its water resources was acquired by force. Likewise, Syria’s increasing diversions from the headwaters of the Yarmouk, backed by reference to its upstream riparian position, clearly violates the agreement. What should be regarded as "equitable" and rightful allocations in the positive sense of the term, however, remains to be determined through negotiation between the parties themselves and codified in bodies of conventional law.

5.2 Water in the Israeli-Jordanian Peace Treaty

The "Treaty of Peace Between The State of Israel and The Hashemite Kingdom of Jordan" of October 26, 1994 was the result of three years of negotiations and is one of the highlights of the current Middle East peace negotiations. Settlement of bilateral water disputes is a centerpiece of the agreement - besides definitive mapping of the common border, security stipulations, definition of the rights and responsibilities of the Hashemites towards holy sites in Jerusalem, and the refugee question (the latter handled in a very dilatory manner). Water issues are addressed in the main body of the treaty, and they fill all of Annex II. This means that water is one of the issues treated most widely and in detail. (In the following the treaty is quoted from according to the version publicized by Israel’s Foreign Ministry, Information Division.)

The heading of Article 6 of the treaty is simply "Water". Paragraph 1 provides for mutually recognizing "rightful allocations" of the Jordan and Yarmouk rivers’ surface waters and ground water of the Arava Valley. Although neither the doctrine of "equitable apportionment" of international water law (see chapter 5.1) nor its criteria are explicitly mentioned, the notions used in the article follow the spirit of those rules. In paragraph 2 both sides recognize "that the subject of water can form the basis for the advancement of co-operation between them". In the meantime, both sides bind themselves to "not, in any way, harm the water resources of the other Party" by their own water development projects. Based on recognition in paragraph 3 that the present water resources of the two countries "are not sufficient to meet their needs", paragraph 4 provides a frame for future cooperation in the water field. This cooperation shall concern all aspects of water management and development, including development of new water resources (with explicit reference to the possibility of transboundary water transfers), minimizing wastage, preventing pollution, dealing with shortages, as well as data exchange and joint research.

While the abovementioned stipulations in the treaty’s main body are of general character, Annex II provides the real operational part of the water-sharing agreement. Article I to IV of the Annex deal, respectively, with detailed allocation of water from the Yarmouk and Jordan rivers, storage and diversion facilities, protection of water quality, and allocation of groundwater in the Arava Valley. Article V concerns the commitment of the two parties not to carry out any changes in the course of the Jordan and Yarmouk without previous agreement, and to notify the counterpart in advance of any intended project. Article VI enforces the obligation to exchange data and to cooperate. Finally, and potentially most important of all, Article 7 envisions the establishment of a Joint Water Committee to drive forward and supervise the implementation of the Annex.

In terms of water sharing, the agreement stipulates a series of detailed provisions, which would be ponderous to set out in their entire length. In practice, Art. I, 1.a and b of the Annex fixes Israel’s share of the Yarmouk’s waters at 25 mcm/year (12 in summer and

13 in winter; plus 20 mcm which Israel is allowed to pump into Lake Tiberias in winter, but has to give back to Jordan in summer). This means a consistent reduction compared to present diversions, which amounted to 70 mcm/year on the average during the last two decades (see chapter 3.1.2). Jordan's share of the Jordan River, on the other hand, is fixed at a minimum of 30 mcm/year, compared to virtually nothing today. These latter quantities of water from the Jordan River will not be provided at the expense of present Israeli consumption. 20 mcm shall be gained through catching the winter floods of the Lower Jordan River, which until now were released unused [Annex II, Art. I, 2.b]. The remaining 10 mcm will be produced by desalinating saline springs around Lake Tiberias which used to be diverted into the Lower Jordan. Until the water treating plant is operational, Israel will supply this latter quantity to Jordan from Lake Tiberias directly [Annex II, Art. I, 2.d]. Implicitly, the rest of the two rivers' flow is left to the disposal of the respective other party - on proviso of the other riparian rights which are not mentioned at all in the treaty.

In Article II of the Annex, the treaty contains provisions for concrete water projects to be carried out in common by the signatories. Paragraph 1 stipulates that "Israel and Jordan shall cooperate to build a diversion/storage dam on the Yarmouk River directly downstream of the point 121/Adassiya Diversion". This is an explicit reference to the building of the long-aspired Jordanian dam on the Yarmouk, which will allow Jordan to store the winter floods of the river and improve its diversions into the King Abdullah Canal. In Jordan's view the dam will provide an additional 50 mcm/year of water to the country. However, this amount is not explicitly fixed in the treaty. A second common storage system is planned on the Lower Jordan River in order to implement the provisions mentioned in Art. II, 2.b (see above). Further storage reservoirs might be discussed and agreed upon mutually [Annex II, Art. II, 3].

In addition to all this, the Annex stipulates in Art. I,3 that "Israel and Jordan shall cooperate in finding sources for the supply to Jordan of an additional quantity of (50) mcm/year of water of drinkable standards". Concrete plans and details concerning the origin of this additional water remain to be defined. They will be developed by the Joint Water Committee within one year of the coming into force of the treaty. It is supposed that they will come from some kind of unconventional source, like inter-basin water transfers or a combined desalination/hydropower generation scheme profiting from a sea water conveyance from the Red Sea to the Dead Sea (see chapters 4.1.7 and 4.1.8). However, this latest provision is rather a declaration of intent. As a senior Israeli official pointed out in a briefing for the press, Israel did not commit itself to anything concrete on this point (*Jerusalem Post,* 18 October 1994).

Concerning the implications of the stipulations on the practice of water allocations and the supply of each party, interpretations differ somewhat. In promoting the achievements of the treaty to the public, Jordan's Prime Minister Majali and Chief Water Negotiator Munther Haddadin told the press that Jordan's water gains would be on the order of 215 mcm/year, 175 of them of drinking quality. This would correspond to an increase of about 25% as compared to the present situation. The two politicians assumed that, in addition to the quantities of water mentioned above, Jordan will be able to divert an additional 25 mcm/year from the Yarmouk by its existing facilities, as well as another 40 mcm/year of brackish water from the Lower Jordan River (*Jordan Times*, 19 October 1995; also Elmusa 1995). However, these latter amounts are not mentioned in the treaty.

These optimistic calculations do not take into account the time-factor and other insecurity factors connected with the stipulations. Most of the additional water is supposed to be gained through installations still to be constructed and in part not even conceived. Feasibility studies concerning the storage and diversion dam on the Yarmouk are expected to be concluded in 1997, which means that the facilities might not be completed until far into the next century. By that time, the 50 mcm/year of the Yarmouk's winter floods supposed to be gained through the dam might be jeopardized by continuous and maybe increasing Syrian extractions upstream. Similar considerations apply to the second planned damming project on the Lower Jordan River, supposed to provide 20 mcm of fresh water, and to the 40 mcm of brackish water to be diverted from the same source downstream. Even the 25 mcm of additional water which Jordan's chief water negotiator hopes to divert from the Yarmouk by means of existing facilities do not seem realistic, especially as concerns the winter flow, because of the lack of storage means (Hof 1995: 50). Even more future-oriented and uncertain is the provision to produce 50 mcm of additional water from sources not yet defined.

Realistically, in the very short term Jordan will get only 30 mcm of additional water from Lake Tiberias (20 mcm as the equivalent for Israeli surplus diversions from the Yarmouk in winter; and 10 as a temporary substitute for the prospected desalinated water from saline springs). The 3.5-km pipeline which allows this conveyance began operating in June 1995 (Reuters press digests of 20 and 21 June 1995). In addition, Jordan will presumably catch a part of the supposed 25 mcm by existing facilities at the intake of King Abdullah Canal. All other assumed water gains of the Kingdom are long-term ones and require previous realization of new installations. Most of them are very uncertain due to technical and financial as well as political factors. Closer to this analysis were Israeli reports on the implications of the treaty. Announcing the main provisions of the accord to the press, a senior Israeli official spoke of 50 mcm released to Jordan with immediate effect; an unspecified amount of water to be gained through the planned dams, "for which Israel did not take over any financial commitment", but will ask other countries to finance; and another 50 mcm which "may be found should the regional development visions of Foreign Minister Shimon Peres succeed" (*Jerusalem Post*, 18 October 1994).

Table 5.1
Jordan and Yarmouk Rivers distribution before and after the Israeli-Jordanian Peace Treaty of 1994 (in million cubic meters)

Jordan River

	Israel	***Jordan***	***Source/ Effective Date***
Johnston Plan 1955	*375*	*100*	
Early 1990s (de facto)	*550*	*0*	
After the Peace Treaty	*550*	*+ 10*	*Desalinated springs (Lake Tiberias)/ immediate*
		+ 20	*Dam on Lower Jordan/ long term*
		(+ 40)	*From Lower Jordan, brackish/ long term, insecure*

Yarmouk River

	Israel	***Jordan***	***Source/ Effective Date***
Johnston Plan 1955	*25*	*377*	
Early 1990s (de facto)	*70*	*130*	
After the Peace Treaty	*25-70 *****	*130*	*Existent*
		+ 20	*Lake Tiberias (exchange)/ immediate*
		(+ 25)	*By existing facilities/ immediate, amount insecure*
		(+ 50)	*From planned dam/ long-term, amount insecure*

Additional Sources

	Israel	***Jordan***	***Effective Date***
After the Peace Treaty	*not referred to*	*+ 50*	*Sources to be yet defined/ very long term, highly insecure*

Amounts in brackets are not explicitly mentioned in the treaty. They are based on declarations of Jordan's chief water negotiator Munthir Haddadin towards the *Jordan Times*, 18 October 1994.
** As long as the planned Jordanian dam on the Yarmouk is not realized, Israel will presumably be able to catch more than the allocated 25 mcm/year, and maybe even approach current 70 mcm. For the treaty stipulates in Annex II, Article I, 1.c that "In order that waste of water will be minimized, Israel and Jordan may use, downstream of point 121/Adassiya Diversion, excess flood water that is not usable and will evidently go to waste unused".

Concerning the groundwater resources of the Arava Valley, which represented a minor contentious matter in the bilateral relations (see chapter 3.1.1), an agreement was found in accordance with settlement of the territorial disputes in this area. The agreement restores Jordan’s sovereignty over the disputed lots of land retained by Israel since the first Arab-Israeli war. But Israeli farmers will keep private land ownership rights and property interests both on the land and the wells they have been exploiting so far [Annex II, Art. IV]. The wells’ total yield is presently estimated at 8 mcm/year (Elmusa 1995: 65). Moreover, Israel "within five years" of signing the agreement is entitled to extract additional amounts of up to 10 mcm [Annex II, Art. IV, 1], bringing Israel’s total yield from that area to 8-18 mcm. Elmusa (1995: 65) interprets this concession as a *de facto* water exchange between north and south. Referring to informations given him by senior Jordanian negotiator Haddadin, he states that "the understanding is that Israel can use the water as long as Jordan receives water from across the border with Israel from the north".

In the historical analysis, the agreement on sharing the Jordan-Yarmouk waters picks up some of the principles of Johnston’s Unified Plan of 1955, although the outcome differs from the older proposal for a number of reasons. As in Johnston’s stipulations, the peace treaty entitles Israel and Jordan to the main flow of one river each - Israel the Upper Jordan, and Jordan the Yarmouk - after deducting the other riparian’s minor share. Israel’s future share of the Yarmouk’s waters is even set at the same quota as in Johnston’s allocations (25 mcm/year; although Israel will presumably be able to catch more as long as the Jordanian dam at Adassiya is not realized). Jordan has been pursuing this claim for 40 years. On the Jordan River, however, the Kingdom had to accept a reduction of its supposed quota from the 100 mcm yearly mentioned in the Johnston Plan to 30 mcm. The reduction of Jordan’s original share of the Jordan River waters may seem fair, since the West Bank’s water riparian rights on the Jordan River are no longer counted as part of the Jordanian share. However, the Israeli-Jordanian peace treaty does not settle the question to whom these originally Jordanian rights may now be transferred. One would suppose that this share should now belong to the Palestinians.

Furthermore, for a number of other reasons the practical outcome differs from the historic stipulations in some essential points. It is true that, as in Johnston’s plan, both Israel and Jordan are theoretically allocated the bulk of the flow of one river each after deducting the other riparian’s minor quotas. But because of the pure bilateral nature of the treaty and the peculiar strategic positions of the two countries in 'their' respective basin, Israel and Jordan are affected in very different ways by the water use of the remaining riparians with whom water agreements are still lacking. On the Jordan River, thanks to control of the Golan Heights and Southern Lebanon and the upstream position towards the West Bank, Israel is presently in a *de facto* position to exclude the remaining competitors from using the river’s water. In the case of a withdrawal from occupied territories in connection with eventual peace agreements with Syria, Lebanon, and the Palestinians, Israel will probably be able to insist on limited quotas for them, thus continuing to secure the bulk of the Jordan River's flow for itself.

Jordan, on the other hand, is not in the same situation on the Yarmouk. Since it remains a downstream riparian and lacks the military means to compensate its weak geographic position, it has to accept increased diversions by upstream riparian Syria. These extractions presently amount to an estimated 160-200 mcm/year (see chapter 3.1.1), thus far surpassing the quota of 90 mcm/year assigned to Syria in 1955. According to some authors (*e.g*. Gruen 1992: 15), Syria is even planning to increase its extraction up to 244 mcm/year and more. Therefore, Jordan will presumably never get the 377 mcm/year from the Yarmouk which it had originally been allocated in the Johnston Plan. Given this situation, future disputes over water rights on the Yarmouk River are likely to shift from the Israeli-Jordanian to the Jordanian-Syrian track.

Despite the deductions Jordan had to accept, the agreement is probably the best it could get in the bilateral trail under the conditions given. Its water supply will be enhanced by about 7% in the short and 15-20% in the long term, if all the planned projects are realized. Moreover, the treaty opens the prospect of further Israeli-Jordanian cooperation, which will bring further gains, both in water management and other sectors.

In technical respect, the agreement is a clever combination between partial redistribution of existing water on one side, and an explicit commitment to gaining extra resources through cooperation on the other. This is highlighted by the fact that not all the additional water that will be allocated to Jordan goes at the expense of Israel. The greater part of it will be produced by new projects which, like the damming of the Yarmouk and Lower Jordan, can only be realized in common. Thus the zero-sum game in sharing water was complemented by cooperative win-win strategies, making a compromise easier. Especially the weaker side, Jordan, which had to accept the greatest deductions from its original claims, was compensated by the prospect of gaining from agreed-upon cooperation in the future. As the Jordanian side has made clear in a written submission to the European Union, "Without these projects, Jordan would have insisted to obtain more water from Israel to reach an agreement" (Hashemite Kingdom of Jordan 1994; as quoted in Hof 1995: 49).

Moreover, the treaty contains a number of concrete stipulations aimed at creating functional interdependencies between the parties. Inter-seasonal water exchanges, storage of part of Jordan's Yarmouk share in Lake Tiberias during winter, and damming projects to be carried out jointly on the common border are supposed to create links and shared interests. When implemented, these joint water projects will have the potential to cement peace between the two countries.

However, the settlement remains bilateral and thus conditional upon behavior of the other riparians (especially Syria), with whom water agreements are still lacking. The Israeli-Jordanian peace treaty, although a hopeful first step on the path to a comprehensive solution of the water disputes in the Jordan Basin region, must be complemented by further agreements with the remaining riparians. Or, even better, it should be replaced by a basin-wide agreement encompassing all parties involved. Technical formulas and mechanisms applied in the Israeli-Jordanian water agreement can give important indications on how water disputes in the other negotiation trails might be settled. But the peculiarities of each track should also be taken into account.

5.3 Water in the accords between Israel and the PLO

While the Israeli-Jordanian Peace Treaty was the final stroke under a longer negotiation process, fully normalizing relations between the two countries, the same cannot be said of the agreements between Israel and the PLO. The widely regarded "Declaration of Principles on Interim Self-Government Arrangements" between Israel and the Palestinian Liberation Organization of September 13, 1993 must rather be characterized as the starting point of the process. Through their mutual recognition, Israel and the PLO only created the *preconditions* for serious negotiations. Peace itself still remains to be achieved.

The Declaration of Principles (which is also called the "Oslo Agreement" because of the mediatory role of the Norwegian government) laid down a two-step path to settling the Israeli-Palestinian conflict. In a first interim period lasting five years, Palestinians would be given autonomy over certain spheres of control in the Occupied Territories, beginning with an Israeli withdrawal from the Gaza Strip and Jericho area. This period is envisaged as paving the way for a permanent settlement which should define the definitive political status of the territories, including Jerusalem, refugees, settlements, security arrangements, borders, and foreign relations. Negotiations on permanent status should commence no later than two years after the interim period begins.

Discussion of water-related matters in the treaties between Israel and the PLO must always keep in mind this limited range of the stipulations achieved so far. The Declaration of Principles is not yet a peace treaty settling the conflict. Even concerning the planned five-year interim period, it only provides a broad framework and point of reference. Practical implementation of Palestinian self-government during this transitory period remains to be agreed upon in subsequent, more detailed arrangements. Until now, with considerable delay compared to the original timetable, two such agreements have ensued: the "Agreement on the Gaza Strip and the Jericho Area" of May 4, 1994 (also called "Cairo Agreement"), specifying the terms of Israeli withdrawal from the Gaza Strip and Jericho; and the "Agreement on Preparatory Transfer of Powers and Responsibilities" of August 29, 1994, extending Palestinian autonomy over a few spheres of civil life - but not water - in the rest of the West Bank. Remaining on the agenda is the Interim Agreement itself, which will specify both the arrangements for Israeli troops redeployment, modalities of elections to the Palestinian Council, and definitive powers of the Palestinian Authority in all the Occupied

Territories. Especially the latter point is of paramount importance in our context, since it directly concerns the question of control over water.

5.3.1 The Declaration of Principles

Thus the following analysis of the status of Palestinian water rights during the interim period is based on still unfinished work. The Declaration of Principles itself fails to make clear the extent to which water should be under Palestinian control during the interim period. In Article VII (4) of its main body, the treaty stipulates the constitution of a "Palestinian Water Administration Authority" to be established after the Interim Agreement within the framework of the Palestinian Council. But it is not made explicit whether "administration" only means management of water distribution systems and wastewater collection or if it includes some kind of jurisdictional control over the resources themselves. (Here and in the following both the Declaration of Principles and the Gaza-Jericho Agreement are quoted according to the versions publicized by Israel's Foreign Ministry, Information Division on the own *Israel Information Gopher*.)

The question of water rights is addressed again in Annex III, dealing with economic cooperation and development, but in a rather vague manner. Here, the two parties agree on establishment of a continuing joint Committee for Economic Cooperation, focusing, among other things, on cooperation in the field of water. The task of this committee "will include proposals for studies and plans on *water rights* of each party, as well as on the *equitable utilization* of joint water resources for implementation in and beyond the interim period" (Article 1; emphases by the author). This passus pronounces important concepts such as the implicit entitlement of both parties to "water rights" and the principle of "equitable utilization", which is a well-known concept in international customary law applied to the sharing of international water bodies (see chapter 5.1). However, the context mentioned is that of "proposals for studies and plans", thus not implying any concrete commitment.

5.3.2 The Gaza-Jericho Agreement

The Gaza-Jericho Agreement goes somewhat further concerning the first point mentioned, the powers of the Palestinian Authority. To concretize the functional extension of these powers, Annex II, Article II (B.31,a) stipulates that "All water and sewage (...) systems and resources in the Gaza Strip and the Jericho Area shall be operated, managed and developed (including drilling) by the Palestinian Authority in a manner that shall prevent any harm to the water resources". At first glance, this arrangement looks quite generous, giving full control over water resources to the Palestinian Authority provided that harm to the resources will be avoided. But the next subparagraph b) then puts limitations on this stipulation: "... the existing water systems supplying water to the Settlements and the Military Installation Area, and the water systems and resources inside them continue to be operated and managed by Mekoroth

Water Co.", the contractor of Israel's Water Authority. Subparagraph c) states that allocations to the settlements and military areas shall remain unaltered.

Moreover, the Gaza Strip and Jericho area are downstream and water deficit zones. Their control by the Palestinian Authority does not increase their water supply. On the contrary, the Palestinians were saddled with water crisis areas. The Palestinian Authority will even be forced to fall back upon water deliveries from Israel. The agreement stipulates on this point that "The Palestinian Authority shall pay Mekoroth for the cost of water supplied from Israel and for the real expenses incurred in supplying water to the Palestinian Authority" [Annex II, Article II, B.31,e].

Yet the political position of the Palestinians could have been improved if the Cairo Agreement had served as a model for the Interim Agreement and thus the powers granted in it would later be transferred to the whole West Bank. Unlike Gaza and Jericho, the latter is a water surplus area, and lies upstream of Israel. Jurisdiction over the waters of the West Bank would, at least formally, put the Palestinian Authority in a more convenient position. However, extension of the powers granted from Gaza and Jericho to the rest of the Occupied Palestinian Territories was not foreseen as an automatism. The Gaza-Jericho Agreement itself states in Article XXIII (5) that "Nothing in this Agreement shall prejudice or preempt the outcome of the negotiations on the interim agreement or on the permanent status (...)".

5.3.3 The Interim Agreement

In fact, the following negotiations over extension of Palestinian self-government to the rest of the West Bank foundered among other things on the question of water. Throughout the summer of 1995, the date for signing the Interim Agreement had to be put off several times because the two parties could not agree on a number of issues including: the size of the Palestinian Council and participation of residents from East Jerusalem in the elections; security arrangements for Hebron; control over the electricity grid in the territories; and - among the critical ones - control over state land and water resources. While the Palestinian side claimed a higher share of the common aquifer in recognition of their water rights, the Israeli side insisted on maintaining the current ratio of distribution until an agreement on the permanent status of the territories has been reached. Israel would assist the Palestinians in finding alternative water resources - *e.g.* through desalination -, and it would not object to Palestinian drilling along the Eastern Aquifer, which has no hydrological connection with the Jewish State and where some 50-60 mcm/year of brackish water are still unused (see chapter 1.4.1). But Israel will not change its present quota of West Bank groundwater in favor of the Palestinians, Foreign Minister Peres and other Israeli officials stated on repeated occasions. It seems that Austria had considered providing loans with generous financial terms to the Palestinians to construct a desalination plant in Gaza. But Palestinians refused to accept this as a solution to the water dispute (*Israel Line*, 20 July 1995; The *Jerusalem Post Intl. Ed.,* 29 July 1995). In the meantime, commentators in the Israeli press urged the government not to give up physical control for any reason over the groundwater of the West Bank (Schiff 1995a; Yacobovitz 1995).

Disagreement on water has highly political implications since it concerns the question whether powers released to the Palestinians shall include just *functional* authority over the Arab residents on the West Bank or also *territorial* authority over the area, including control over resources. Independent commentators agreed that this was the main obstacle to find an agreement in this phase of Israeli-Palestinian negotiations (see *e.g., The Economist*, 5 August 1995; also *Financial Times*, 8 August 1995). On August 11, 1995 a joint statement was initialized by Israeli and Palestinian chief negotiators in Taba, and a new date for signing the Interim Agreement was fixed for September. But once more, the water dispute belonged to those matters to which no solution was found. Therefore, water concerns had to be postponed to further negotiations. A joint committee with the USA participating has been commissioned to take over the issue.

However, it is likely that Israel will achieve its main water-related demands during the interim period. For according to the Taba Statement, the West Bank will be divided into three areas: A - the urban areas, B - the rural areas inhabited by Palestinians, and C - everything else, including state land, Israeli settlements, military installations and areas important from a security standpoint (*e.g.* the border region in the Jordan Valley). Before Palestinian elections, Israeli army will withdraw from area A and redeploy in area B. This is only 27% of the West Bank area. In area C, only civil powers unrelated to territory will be transferred to the Palestinians. In a later, three-staged phase to be completed in 1997 "powers and responsibilities relating to territory will be transferred gradually to Palestinian jurisdiction (...), *except for the issues that will be negotiated in the permanent status negotiations*" (quoted according to the version publicized by Israel’s Foreign Ministry, Information Division on *Israel Information Gopher*; emphases by the author). This seems to imply exclusion of water rights' from talks on Palestinian self-government in the interim phase, since according to Israeli interpretation of the Declaration of Principles, question of water control and distribution is part of the political core issues which shall be addressed only in negotiations on permanent status. These talks are scheduled to begin in May 1996 and to last another three years.

In fact, on 24 August the two sides reached a further agreement on principles concerning the water issue which seems to confirm this position. In the document Israel officially recognizes "Palestinian water rights in the West Bank". But in return the Palestinians had to agree to postpone discussion on definition of these rights until negotiations on permanent settlement (*Ha'aretz*, 25 August 1995, as reported by *Israel Line*, 25 August 1995). Will the rights include jurisdictional control over resources or just entitlement to certain water amounts? And which amounts of water are implied? Especially, is any increase in the Palestinian quota foreseen? These important questions remained unclarified. Thus the agreement is unsatisfactory for the Palestinian side. At completion of this study in late August 1995, talks dealing with the water issue during the interim period were still underway. Negotiations were overshadowed by several terrorist attacks from the side of Palestinian extremists, violent protests by Jewish settlers against the peace process, and disputes over the Palestinian Authority's extradition policy.

5.3.4 The Israeli-Palestinian water dilemma

Given the very complex nature of the Israeli-Palestinian conflict, the Oslo timetable with its two distinct steps towards resolution of the conflict makes sense and should not be changed. In the field of water, however, this approach impedes the integration of water management and distribution issues, as it was fruitfully applied in the Israeli-Jordanian negotiations (see therefore chapter 5.2). For the Palestinian population in the Occupied Territories postponement of all the critical questions to a later date and the slow pace in improvement of their living conditions - to which belongs, not least, the water supply - are reason for great disappointment and bitterness. Indeed, both the Oslo and the Cairo Agreements provide for Israeli-Palestinian cooperation in the field of water management and joint development of additional water resources (*e.g.* Annex IV, Art. 2.B of the Declaration of Principles). But the sharp separation of technical dimensions of water management from the political question of water distribution is blocking any progress in this field.

Issues of water management and water distribution are simply not separable. The reason for this lies in the fact that improved management is normally coupled with high economic, social and/or political costs. This is especially the case when management options imply development of unconventional resources like sea water desalination or water imports from distant regions or restructuring of water-intensive branches like irrigated agriculture (see chapters 4.1.6, 4.1.7, and 4.2.4). An implication of such projects within a regional framework will always pose the question of who will bear the burden. Each party will compare costs of additional water with costs of conventional resources. And no party will agree to expensive solutions if it believes it has outstanding claims to existing supplies.

To illustrate the dilemma a brief verbal exchange between an Israeli and a Palestinian representative at the First Israeli-Palestinian International Academic Conference on Water, held in Zurich in December 1992, is quoted. The Israeli proposed to jointly build sea water desalination plants to overcome the water crisis in the region. The Palestinian retorted that he had nothing against Israel building the factories. But the Palestinians possessed neither the financial means nor sensed the need to participate in such projects. Because on the West Bank they were entitled to enough natural water resources to cover their needs for the next decades.

Isolation of the two issues, both in functional and temporal respect, is thus impeding joint Israeli-Palestinian cooperation projects in the field of water. Under these circumstances, Israeli offers to provide the technology - supposed to be financed by external donors - for supplying unconventional water to the territories are to be viewed by the Palestinians as an attempt to bypass the sensitive question of redistributing shared existing resources. Technical cooperation, although highly desirable, hardly seems achievable in a situation of extremely asymmetric distribution and persistent disputes over claims to the existing resources. (For suggestions on how to overcome the impasse see chapter 6.2).

5.4 The Multilateral Working Groups on Water and Environment

Besides the best-known bilateral negotiations between Israel and each of its neighbors, the Middle East peace process encompasses a second, less well-publicized, *multilateral* track of negotiations. The multilateral talks draw on a wider set of issues and participants. They were designed by the architects of the peace process to address functional issues on a region-wide basis as a complement to the bilaterals. Thus, the multilateral talks are divided into five working groups dealing with: 1) management of regional water resources, 2) the refugees question, 3) environmental problems, 4) regional economic development, and 5) arms control. On one hand these issues are themselves sources of tension and instability. On the other, they are supposed to be potential fields of future regional cooperation. Accordingly, participants in the multilateral talks were thought to include not only the immediate protagonists of the Arab-Israeli conflict, but also states from the rest of the Middle East and North Africa, and potential donor countries like the USA, the EU, Japan, and others. (An excellent outline of the aims and structure of the multilateral talks is provided by Peters 1994; see also Djerejian 1993)

The multilateral talks began in Moscow in January 1992. So far seven rounds have taken place in over 20 cities throughout the world. In accordance with the nature of the multilaterals, the working group on water resources focuses on such technical matters as improvement and exchange of data, means to improve water supply, water management and conservation, and plans for regional projects - rather than on the properly political question of water shares and water rights. The group on the environment, on the other hand, focuses on combating marine pollution, halting desertification, safeguarding drinking water, and wastewater management.

One of the great merits of the multilaterals is that they provided a unique forum for low-risk communication between Israel and the Arabs. The numerous meetings of the working groups and inter-sessional activities in various parts of the world multiplied the channels of interaction and occasions for representatives of parties to meet discretely without provoking excessive attention by the media. It may not be a coincidence that the so-called 'Oslo connection', which opened the way to the secret talks and subsequent signing of the Declaration of Principles between Israel and the PLO, constituted itself within the frame of the multilaterals. Terje Larsen and Mona Juul, the couple of Norwegian scientists who initiated contact between Israelis and Palestinians, were carrying out a study on living conditions in the Occupied Territories commissioned by the working group on refugees. Many of the secret encounters took place on the occasion of sessions and inter-sessional activities of the multilateral talks (Corbin 1994).

Moreover, the multilaterals provided a frame for breaking long-standing taboos or experimenting with new formulas which were later successfully applied in the bilateral track. For instance, the Palestinian representatives, who according to the original terms of the peace negotiations were included in the Jordanian delegation, were first allowed to form a delegation of their own within the framework of some of the multilateral working groups. Later, it became natural for them to form a distinct delegation in all bodies of the process. The same happened with inclusion of Palestinians from East Jerusalem and the Diaspora in the negotiations. For Israel, on the other hand, the multilaterals were a means to achieve a détente in its relations with the wider Arab world. Since some meetings of the working groups took place in Arab capitals, this provided the occasion for official Israeli delegations to visit them and initiate processes of normalization. Worth mentioning in this context is the meeting of the working group on water in Muskat (Oman), which was the first official Israeli delegation ever to visit a Gulf State.

A further effect of the multilateral negotiations was to encourage a 'third track' of talks at the academic and nongovernmental level, consisting of informal meetings and conferences among experts and professionals in the fields concerned. In the field of water, a pioneer role was played by the "First Israeli-Palestinian International Conference on Water" convened at the Swiss Federal Institute of Technology in Zurich in November 1992 under joint sponsorship of the Truman Research Institute for the Advancement of Peace at the Hebrew University and the Jerusalem Centre for Strategic Studies (generally known by its Arabic acronym, MAQDES) (the proceedings of this conference are published in Isaac & Shuval 1994). Several similar academic meetings took place in the following years, and upcoming events are scheduled for the future. Besides producing much useful expertise, the development of such a 'third track' of talks helped to widen discussions on the peace process from the narrow political scene into the civil societies of the parties involved (see also Brooks & Lonergan 1994: 215f.).

However, in their proper range of action, the single working groups show quite different practical results. The group on the environment probably was the most productive in concrete decisions. In the field of combating marine pollution in the Gulf of Aqaba, an expert team from Israel, Jordan, and Egypt, assisted by a European consultancy company, has formulated a joint action program based on the establishment of centers to combat oil-spills in each of the three countries. Supervised by a steering committee, the three centers will cooperate to minimize damages in case of large-scale oil pollution. The agreement was finalized in January 1995. The centers in Aqaba (Jordan) and Nuweiba (Egypt) will be financially supported by the European Union.

Another result of discussions within the environment working group was an Environmental Code of Conduct which was unanimously approved by all participants in the sixth round of talks in Bahrain in October 1994. The code establishes common guidelines and norms which should govern development policies of each state in a manner that will not adversely affect the environment of neighboring countries. Although its character is rather that of a resolution without formal obligation, the document is supposed to help define the future direction of environmental programs and legislation in the region, and to serve as a basis for research and scientific development. Further activities in the group concern the building up of an environmental impact assessment infrastructure in countries of the region, which was suggested by Canada; and an action plan by the World Bank for collaboration to control natural resource degradation and desertification, including the setting up of regional thematic centers on each of the participating sides. Although some training workshops have already taken place, the main points of these latter two initiatives still need to be implemented (Amir 1995; also Warburg 1995).

Negotiations within the environmental working group profit from the fact that issues dealt with belong to the least controversial, since pollution problems in the proper sense of the word seldom commingle with territorial disputes and do not involve competition over scarce resources. In addition, a basis for environmental cooperation between Israel and its neighbors has already been in existence for over 15 years within the framework of the Mediterranean Action Plan. The multilateral talks on water were more difficult in this respect. The group produced a lot of useful expertise, and several proposals are under discussion which might become fields of cooperation in the future: from an Omani proposal to establish a regional research center on desalination technologies in Muscat, through different water enhancement plans, to a USA/EU plan for regional water data banks (Israel Foreign Ministry 1994b). But so far the group has been unable to reach any important concrete decision.

The reasons for this meager outcome lie in part with political obstacles encountered during the talks. First of all, the multilateral talks have so far been boycotted by Syria and Lebanon, which argue that the Arab states should not discuss functional matters prior to a settlement of political core issues at the bilateral talks. Thus the original idea of enforcing basinwide cooperation in the Jordan River Basin was undermined from the very beginning. Furthermore, differing views of those participating also burdened the discussions and impeded greater breakthroughs. On the one side, Israel insisted on purely technical matters, arguing that pragmatic steps in joint water management should be dealt with independently from the question of water rights and shares. The latter, in this view, belong to the political sphere and thus must be discussed in the bilaterals. The Palestinians, on the other hand, insisted especially on this political dimension of the issue. They saw settlement of the question of water rights and shares as a precondition to cooperation and thus as pivotal to regional water management (see also chapter 5.3.4).

Another reason for the apparently meager results in the working group on water seems to be inherent in the nature of the multilaterals as part of a wider process. The dynamic of the Middle East peace negotiations implied that, with the signing of first agreements on the bilateral track, a series of further forums also dealing with functional cooperation were established outside of the multilaterals. Such examples are the Israeli-Palestinian Economic Cooperation Committee and the Israeli-Jordanian Joint Water Committee. In this respect, the work of the multilaterals has not been in vain. Rather, the ideas and expertise produced by them flowed partly into bilateral agreements or are still being discussed within the framework of newly-established negotiation bodies. An example for that is the project of a joint Israeli-Jordanian canal connecting the Red Sea to the Dead Sea. The canal aims to exploit the 400 meters difference in altitude between the two seas for hydro-power generation and eventually using a portion of the energy to desalinate sea water (see also chapter 4.1.8). The plan was discussed in the multilateral talks on regional economic development and is now envisaged as a project within the framework of bilateral cooperation between the two countries. Peters (1994: 35) has pointed out that "in this sense the multilateral talks have been contributing to the post-settlement phase of the Arab-Israeli Peace Process".

6 Conclusions

6.1 Calling for integration of water diplomacy and water management

The analysis of the hydropolitical dimensions in the Arab-Israeli conflict proved the problem to be a very complex and multilayered matter. On the various bilateral tracks of the Middle East peace negotiations water concerns are interlinked in different ways with political and territorial core issues of the conflict. Hydrological issues have been treated in all major agreements achieved so far, both on the Israeli-Jordanian and Israeli-Palestinian trails. The most far-reaching results were obtained in Israel-Jordan negotiations where the water issue could be regarded as a genuine hydrological concern, quite independent from the other political dispute (see chapter 3.1.2). The bilateral Peace Treaty of October 1994, besides clarifying the distribution of shared resources, explicitly lists a series of concrete water projects to be carried out in common in the immediate future, and further projects still to be defined (see chapter 5.2).

Water management had even previously been indicated by many experts as one of the most urgent and promising fields for regional cooperation (Naff & Matson 1984; Shuval 1992; Baskin 1993; Starr & Stoll 1988; and others). Regional water management is intended both as a means to alleviate the water crisis itself and as a vehicle to foster understanding and establishment of interdependencies among parties of the Arab-Israeli conflict. In the tradition of the functionalist and neo-functionalist schools of thought, the hope is that, by creating a new perception of shared needs and interests, cooperation in the field of water could ease resolution of the underlying political conflict. In fact, most of the technical options for improving water management discussed in chapters 4.1 and 4.2 require inter-state cooperation, or at least can profit greatly from it. Regional cooperation is inevitably needed in those projects that aim to develop remaining natural resources flowing on the border between different parties, as well as in all discussed projects of inter-basin water transfer. But even those management options which would ultimately have to be implemented on the national level, such as recycling and conservation, sea- and brackish water desalination, as well as water pricing and other institutional adjustments could greatly profit from common efforts in the field of research, data exchange, and technology transfer.

However, the experiences made so far in the peace process showed that cooperation in the field of improving water management cannot be achieved independently of settling disputes on distribution of existing resources. On the contrary, one formula for success achieved in the Israel-Jordan peace treaty was the explicit combination of political and technical approaches within the same legal regime. Settlement of the distribution conflict was the prerequisite for making possible the provisions on envisaged cooperation. On the other hand, concrete projects fixed in the treaty helped overcome the zero-sum game on the distribution question and thus made a compromise easier (see chapter 5.2). This integration of the two approaches profited from the two-track architecture of the current peace process, which from the very beginning organized discussion of functional issues in parallel multilateral negotiations (see chapter 5.4).

The main reasons why technical aspects of water management are not separable from the political problem of water distribution lies in the fact that improved management is normally coupled with high economic, social, and/or political costs. Implementation of great projects in a regional frame will always raise the question of who will bear the burden. Each party will compare the costs of additional water with the costs of conventional resources. And no party will agree to expensive solutions if it believes it has outstanding claims to existing supplies. On the other hand, under present supply conditions and consumption patterns, and in view of continuing population growth, any simple redistribution of existing water resources within the framework of a purely political settlement will hardly be feasible either. Even if it was, it would not provide a sustainable solution to the problem of water scarcity itself, thus fueling new conflicts in the future. This means that management and distribution approaches must be integrated without giving any hierarchic preference to one or the other. The financial support of water management projects by donor countries can help ease the meeting of the two requirements and is thus very important. But it cannot overcome the need to address the distribution issue as well.

Discussion so far tended to emphasize either the purely technical approach or the political one. This often depended on the professional background of the authors. But in some cases, the choice may also have had political motivations. Stressing only the technical and management dimension of the water crisis can be a means of evading the unpleasant matter of an unfair distribution which needs adjustment. On the other hand, putting emphasis only on water diplomacy may reflect a cognitive barrier against seeing water scarcity as a regional problem that affects all parties involved. This is a shorttermed view which hinders international cooperation. Ultimately, both one-sided approaches will impede solution of the problem.

6.2 Overcoming the Israeli-Palestinian water impasse: some suggestions

Hydropolitical negotiations on the Israeli-Syrian-Lebanese and Israeli-Palestinian track of the peace process are less advanced than between Israel and Jordan. In the first case the water question is mainly to be regarded as part of strategic concerns and is thus subordinate to settling this dimension of the conflict (see chapter 3.2.2). Nevertheless, talks about functional issues like water management could intensify interactions on this track and thus contribute to the confidence building needed for such a political settlement. This approach has been impeded so far by Syria’s and Lebanon’s boycott of the multilateral talks. Future involvement of these two countries in the multilateral process seems therefore of great importance and should be encouraged by the sponsors of the peace process.

In the Israeli-Palestinian case, disputes over water rights are intrinsically interwoven with the political core issues of the open Palestinian Question. Both controversy over the powers of the nascent Palestinian political entity, its definitive borders, and the problem of Jewish settlers directly affect access to and control over shared water resources (see chapters 3.4.2). Separate examination of the water problem on the Israeli-Palestinian track is therefore not possible. Rather, water disputes and the proper political conflict can only be solved together in terms of a process. Progress in the proper political sphere will enable first steps of cooperation in practical spheres such as water management. Functional cooperation, for its part, could enforce the trust needed for further progress at the political level. Only such a multilayered approach can lead to solutions for issues which, like the Jerusalem question or the settlement and the refugees problems, seem virtually unresolvable.

However, the prospect of cooperation in the field of water management is blocked by the current negotiations timetable. According to it, the question of water rights must be discussed - as part of territorial and political matters - only in a second phase, within the framework of negotiations on the permanent status of the territories. Thus, both the Oslo and Gaza-Jericho Agreements, as well as provisional stipulations for the Interim Agreement on self-government in all of the West Bank, implicitly confirm the current, highly asymmetric pattern of distribution (see chapter 5.3). This postponement of the distribution problem impedes the same fruitful integration of water management and water diplomacy as was applied in the Israeli-Jordanian peace treaty (see chapter 5.2). In the multilateral track of the negotiations separation of the two issues has been impeding progress in implementing Israeli-Palestinian technical cooperation (see chapter 5.4).

Overcoming the deadlock requires in the *short term* pragmatic confidence-building measures in order to enable signing of the Interim Agreement on Palestinian Self-Government in all of the territories. These measures must encompass more than just

Israel's political recognition of future Palestinian "water rights", as happened in the provisional agreement of 24 August (see chapter 5.3.3). Above all, concrete improvements in the water supply on the ground are needed. Beside political considerations, this is imposed by humanitarian concerns. As outlined in chapters 2.3.1 and 2.3.2 per capita water consumption in the Palestinian households lie far below 100 liters per day, which is the minimal requirement for health and sanitation fixed by the WHO. Also water quality, especially in the Gaza Strip, is below health-sustaining standards. In the December 1994 report of the UN Commission on Human Rights on the situation in the Occupied Territories, Special Rapporteur René Felber, former Foreign Minister of Switzerland, explicitly referred to insufficient water supply as an area in which basic human rights are violated (United Nations, Economic and Social Council, Commission on Human Rights 1994). Recently, even Israeli TV addressed the issue in these terms when it brought a report on the water situation in the Palestinian town of Hebron. The report showed flowering gardens and swimming pools of Jewish settlers while Palestinians lacked even drinking water. Israel's Environmental Minister Yossi Sarid from the Meretz Party called the situation "repulsive and embarrassing" and added that "never has Jewish morality been as distorted and subject to ridicule as it is expressed in the reality of Kiryat Arba", the Jewish settlement near Hebron (*Shomron News Service* No. 615 of 19 August 1995; also *Neue Zürcher Zeitung,* 21 August 1995).

The proposal is that Israel should markedly raise the water quota allocated to Palestinian domestic consumption. To be explicit: the author is thinking about doubling supply to private Palestinian households. This would mean an additional allocation of about 60 mcm/year to the Palestinians (30 on the West Bank, and 25-30 in the Gaza Strip) or about 25% of their present consumption. This would mean that the Palestinians would reach the WHO minimal standards of domestic supply. From the Israeli perspective, this amount makes up for only about 3% of their total consumption.

On the West Bank, the water in question would have to be released from the shared aquifers by increasing the Palestinian quota. A further measure which might be implied in the proposed redistribution is granting the Palestinians full control over the Eastern Aquifer. This has no hydrologic connection with the Israeli motherland and must therefore be regarded as an internal water source of the West Bank (see also chapter 1.4.1). Jewish settlements in the area of the Eastern Aquifer should be supplied from other sources via pipelines or trucks. Where this is not possible for technical reasons and settlers will continue to tap the local groundwater, it is suggested that the Palestinians be given back the respective amount of water from sources suggested by Israel.

In the Gaza Strip the additional water would have to be conveyed from Israel’s Water Carrier. The Palestinian Water Authority should not be charged market prices for this allocation, as stated in the Gaza-Jericho Agreement. Instead, it should be offered at prime cost in partial recognition of Palestinian water rights (Isaac, 1995). In the Strip, this measure would relieve pressure on the local aquifer, thus allowing the beginning of restoration. Implicitly, such a deal could set a precedent for future water exchanges between Israel and a future Palestinian entity within the framework of a permanent settlement. The idea is that, given its chronical water deficit, the Strip will need some kind of additional water source in any case. In the future, instead of conveying West Bank water to Gaza through a 'Palestinian National Carrier', as has been suggested by some advocates of the Palestinian Cause, a much simpler and more economical option would be the release of part of the future Palestinian West Bank quota to Israel which, in its turn, would supply Gaza by existing facilities.

By improving living conditions of the people, such a confidence-building step would demonstrate to the Palestinians that Israel is willing to seek a just and equitable solution to the water dispute. Limitation on domestic needs emphasizes the humanitarian character of the measure (though final allocation would remain within the responsibility of the Palestinian Authority). Formally, such a step would not prejudice the outcome of negotiations on the permanent solution. Thereby the current frame of reference in Israeli-Palestinian negotiations, as fixed in the Declaration of Principles, would not be infringed.

In the *medium term* Israeli and Palestinians, supported by the sponsors of the peace process, should think about anticipating settlement on definitive allocation of shared water resources within the frame of negotiations on permanent solution. Negotiations over the final status of the territories are scheduled to begin in May 1996 and will last at least another three years. This is time which will be lost for urgently needed joint projects in the field of water management and development. This is because long-term planning is unconceivable so long as originary ownership over existing waters remains disputed (see chapters 5.3.4).

Negotiations over the permanent status of the territories will have to address a series of very sensitive issues, including political status and borders of the Palestinian entity, future of Jewish settlements, the Palestinian refugees problem, and status of East Jerusalem (see also chapter 5.3). It is suggested that, similar to the negotiation schedule so far, treatment of these issues should be staggered according to importance and prospects for agreement. In such a frame, the distributive conflict over shared water resources should be settled by a formal agreement at an early stage, before achievement of overall political solution. Beside representing in itself an important step on the path to peace, the strategic goal of this proposal is to bring movement in Israeli-Palestinian talks over technical aspects of water management and development. As between Israel and Jordan, the Israeli-Palestinian water conflict will only be solvable through a combination of partial redistribution and future-oriented cooperation. On the other hand, early progress in this field might intensify interactions and create functional interdependencies, thus fostering readiness of the parties to make compromises in the political core issues.

To ease such a deal the water issue should be handled in terms of "human needs" rather than "rights". This is to disconnect the question of water distribution from the narrowly political and territorial dimensions of the conflict which will be presumably solved only at the very end of the process. Israeli and Palestinian scientists meeting at roundtables under the auspices of the Israel/Palestine Center for Research and Information (IPCRI) have been proposing such an approach for years (Assaf et al. 1993: 16ff.; Baskin 1995). The basic idea of these proposals is establishing a Minimum Water Requirement for urban consumption and some forms of private subsistence (such as vegetable gardens adjacent to homes and animal husbandry). Israel and the Palestinian political entity should be allocated this rate on a per capita basis, eventually taking into account the foreseeable demographic developments.

As a basis for calculating the Minimum Water Requirement Shuval (1992, 1993a) and others (Assaf et al. 1993: 20ff.) adopted an amount of 125 cubic meters of fresh water per person and year (about 350 liters a day). This amount includes 100 cubic meters for domestic, urban and industrial consumption plus 25 cubic meters for watering home vegetable gardens and animals. This is a point of reference, and definitive amount might be a matter of further discussions. But principle should be adopted according to which the agreed Minimum Water Requirement is a basic social need of each individual in the area and should therefore have absolute priority over other uses (see also Dombrowsky 1995: 133ff.). Only waters exceeding the Minimum Water Requirements should be negotiated. Eventually, these latter amounts could be put under an independent Water Authority which would have to allocate them by market mechanisms (see chapter 4.2.6).

The adequacy of the assumed Minimum Water Requirement level is conditional on efficient water use. Thus, on the microeconomic level a prioritary task is to systematically apply technologies and incentives for conservation, recycling, and development of marginal resources (see chapters 4.1.1 to 4.1.5, and 4.2.1 to 4.2.3). This is a potential field for intensive technological cooperation between Israelis and Palestinians, once the distributive dispute is settled. On the macroeconomic level, water scarcity requires gradual structural adjustments aimed at shifting water allotment away from water-intensive agriculture to those sectors of primary social need or with higher water productivity (see chapter 4.2.4 and 4.2.5). This latter option applies especially to Israel, which has far more resources and opportunities to afford economic restructuring in the short and middle term than the young Palestinian entity. But in the long term it also applies to the latter (see chapter 2.4). In the future, agriculture might have to rely mainly on recycled wastewater and other marginal sources.

In the *long term*, assuming that population growth continues at current rates, even supply of Minimum Water Requirements for urban and subsistence uses will be put in question. At this time, measures aimed at increasing fresh water supply such as sea water desalination or water imports (see chapters 4.1.6 and 4.1.7) might become unavoidable. If conceived for providing water to the domestic and industrial sectors, which show a more inelastic demand in relation to price than agriculture, sea water desalination and some of the proposed water import schemes can result as economically affordable. However, these projects are only viable in a context of regional peace and under condition that originary ownership over natural water resources is clarified. They should be regarded as a last resort, after all other options having been exploited.

Yet resolution of the broader Israeli-Palestinian and Arab-Israeli conflict is not only a hydrological matter. Water can be a vehicle of first understanding, enforcing trust as well as awareness that problems might be easier and better solved under conditions of peace. Cooperation in the field also has the potential to become the cement of peace after a settlement. Achieving the political settlement itself, however, will require huge efforts at other levels too, where the influence of hydrological matters is limited if not nonexistent.

7 Epilogue: Weighting Water's Role in the Arab-Israeli Conflict

Considering the genetic account of water disputes in the Jordan Basin region and the analysis of current peace negotiations it can no longer be doubted that water has played and still plays an important part in the Arab-Israeli conflict. However, as always in multicausal conflicts, the interesting question does not so much concern the presence of a certain factor in the causal process. Presumably no one at all will deny the involvement of water in the Arab-Israeli conflict. Rather it is its relative weight within the mix of causal factors that must be evaluated. For the purpose of such a conclusive assessment, and in order to place the study within the wider discussion on 'environmentally induced conflicts', a model developed by David Dessler (1994) will be applied to the dispute in question.

Based on the intentional-actor model of human behavior, Dessler distinguishes four different roles that 'causes' may play in generating and sustaining violent conflict:

- As *Triggers*. Generally speaking, triggers are events causing actions that increase the probability of violence. A distinction must be made between 'proximate' and 'distant' triggers, depending on time, distance, and inherent connection to the conflict itself.
- As *Targets*. A target is a social decisionmaker's objective, aim, or goal. The target is what the conflict is all 'about' in the eyes of the protagonists. Differences and incompatibilities between the involved parties targets are what create the object of contention.
- As *Channels*. Channels are lines of political, social, economic, or national cleavage among groups. To cite a channel is to explain the structures that cause individuals to fall into the groups they do.
- As *Catalysts*. A catalyst is any factor that controls the rate or intensity and the duration of a conflict, once initiated (see also Bächler 1994a).

The following exposition will recapitulate and order some of the main arguments developed during the course of the study by assessing the role of water in each of these four causal dimensions. By doing that, the task is not - and cannot be - to quantitatively determine the exact contribution of water to the Arab-Israeli conflict. Rather, we shall be able to produce a more differentiated picture of the importance of water within the larger struggle - and on how it has contributed to it -, as well as seeing which aspects or features of the conflict cannot be attributed to water or any other environmental problem.

7.1 Has water been a proximate and/or distant *trigger* of conflict and violence in the Jordan Basin region?

Concerning the very origins (or distant triggers) of the Arab-Israeli conflict, water itself did not play any major role. The roots of the conflict are to be seen in the opposition of Arab and Jewish national movements claiming the same piece of land. The struggle was triggered by the endeavor of Zionism to build a Jewish state on the land of their historical ancestors, and by the rejection of it by the indigenous Palestinian population and the neighboring Arab states. Moreover, the dispute is increased by the high religious significance of the land in question for the three monotheistic religions.

Undeniably, hydrological conditions were taken into consideration by the parties from the very beginning of the conflict, *e.g.* determining the delineation of territorial demands by the Zionist Movement at the end of World War I (Wolf & Ross 1992; Wolf 1995; Nijim 1990; see also chapter 3.3). Similarly, disputes over use of single springs and wells between local communities of the two sides accompanied the conflict during both the Ottoman rule and the British Mandatory period. But these geopolitical considerations and the following disputes were rather an outflow of political and territorial conflict than part of its origin. The Zionists chose Palestine as their national home not for hydrological reasons but because of their historic and religious attachment to this specific piece of land. Uganda or Argentina, which at an early stage had been discussed as alternative sites for a Jewish national home, would have been much better watered. On the other hand, the scarcity of resources at the local level may have been one of the factors which motivated the indigenous Arab population to refuse the new neighbors. But again, this is to be viewed within the framework of the overall feeling of threat caused by immigration of foreign people claiming a national home on Arab land. At the political level, the Arab potentates, who at the beginning partly cooperated with the Zionists, did not care much about water.

Later, after foundation of the state of Israel and achievement of independence by the Arab states, water became a critical factor of economic development for all parties involved. Since most waters in the region are transboundary, competition over shared resources turned into one of the proximate triggers of conflict and violence. As has been illustrated in chapter 3.2.1, from 1949 to 1967, water-related projects were at the center of the Arab-Israeli struggle, being both the immediate trigger for repeated hostile actions and the object of a US mediation attempt in the 1950s. Outbreak of the Six Days' War itself was not directly triggered by events related to water. But the chain reaction of border violence which escalated into crisis in June 1967 began with an Arab water diversion project started in 1960 which was endangering Israel's water supply (see chapter 3.2. However, these causal relationship must be seen in the wider political context of a situation characterized by nonrecognition of Israel by its Arab neighbors and a very high degree of mutual hostility. Within this framework, the role of disputed water projects as a proximate trigger of conflict must be seen in both their quality as an object of dispute and as a means of carrying out the deeper historical conflict.

Since 1967, the question of water sharing has again repeatedly been a proximate trigger of tension and single hostile acts, especially in Israeli-Jordanian relations (see chapter 3.1.1). On the other hand, water did not play any major role in the break out of the 1973 war (in which, it should be remembered, Jordan did not participate). In the Israeli-Palestinian conflict, which arose as an independent trail since the 1960s, sovereignty over resources and their distribution is an integral part of the struggle over land and national identity. In this sense, hydrological matters can hardly be discerned as a distinct trigger of conflict. Rather, the issue intrinsically commingles with the Palestinian Question itself, both in its properly political and its territorial dimensions. The severe water crisis in the Occupied Palestinian Territories, coupled with discriminatory practices of the Israeli administration relative to water supply (see chapter 3.4), undoubtedly contributed as a distant trigger to the grievances behind the Palestinian uprising which broke out in 1987.

7.2 Has water been a political and/or military *target* for parties to the Arab-Israeli conflict?

Speaking about the primary political targets of the conflict parties, it must be stated that the Middle East conflict, both in its inter-state Arab-Israeli and its Israeli-Palestinian dimension, is not primarily a struggle 'over water'. The conflict is over national identity and existence, territory, as well as over power and national security. Within this context, however, water has played and still plays the role of an important secondary target in many actions characterizing the conflict. As already pointed out, hydrological concerns influenced the territorial claims of the Zionist movement from the very beginning and has continued to influence strategic thinking in Israel. Some authors have maintained the thesis that, driven by a "hydraulic imperative", capture of additional water resources was a primary motive for Israel to go to war in 1967 and 1982 (*e.g.* Cooley 1984). This is surely a too simplistic interpretation of the matter, not taking into account the strategic situation and real threats Israel was exposed to. Yet, to cite Frey and Naff, "although water may not have been the prime impetus behind the Israeli acquisition of territory, as the 'hydraulic imperative' alleges, it seems to be perhaps the main factor determining its retention of that territory" (Frey & Naff 1985: 76).

Today, depending on whether the territories occupied in 1967 are included into the account or not, the country receives only 21% or else more than 50% of its supply from sources originating outside its own borders. In the current discussion about a 'land for peace' solution of the Arab-Israeli conflict, this circumstance is quite important. Israeli strategists always name control over water sources as one critical factor making necessary, in their view, retention of at least a part of the occupied Arab territories (see chapters 3.2.2 and 3.4.2). Within this framework, 'water security' concerns are mentioned in one go with traditional military security and the issue of Jewish settlements. In recent years the shift in the strategic situation in favor of Israel after the breakup of the Soviet Union and the defeat of Iraq in 1991 even raised water’s relative importance.

On the Israeli-Jordanian track, political developments of the last decade made water the major bone of contention in bilateral relations at the beginning of the 1990s. Since 1988, when Jordan gave up its claims over the West Bank, no substantial territorial differences remain between the two countries. Thus, the dispute over distribution of the Jordan and Yarmouk waters became a manifest and independent conflict target. In the particularly dry summer of 1990 this lead King Hussein of Jordan to state that the only reason which might bring Jordan to war again was water (*The Independent*, 15 May 1990). The implications of that statement were in part exaggerated by the press, since the assumption of an imminent war over water did not take into account other decisive factors such as power ratios and the disproportionate costs of a military adventure. Yet the fact that it was pronounced by the opponent of Israel least involved in political dispute with the Jewish state underlines the growing role water is taking in the dynamic of the conflict. On the other hand, it is just this independent role of the Israeli-Jordanian water dispute, free from other territorial and political implications, which eased achievement of its solution within the framework of the Peace Treaty signed in October 1994 (see chapters 3.1.2 and 5.2).

Moreover, water-related infrastructure has been a military target of numerous skirmishes and wars throughout the course of the Arab-Israeli conflict. Since the early 1950s, when the Syrians fired at the works on the Israeli Water Carrier, through the first anti-Israeli military attacks of the PLO in 1964, up to the Israeli air strikes against Syrian and Jordanian diversion facilities in the second half of the 1960s, hydrological installations have always been a preferred target for actions aimed at weakening or castigating the enemy (see chapters 3.1.2 and 3.2.1). Admittedly, this link must be regarded as a military *instrument* rather than as a causing dimension of conflict. Nevertheless, it emphasizes the importance given to water within the framework of the dispute. As water supplies and delivery systems become increasingly sensitive in water-scarce regions, their value also increases as military targets.

7.3 Has water been a *channel* of the Arab-Israeli conflict?

Channels are that causal dimension of conflict which in general is most distant from environmental factors. The environment very seldom manifests itself as a primary politicizing factor. Group identities are normally constituted by cultural, socio-economic, or ideological cleavages such as national, ethnic, or class affiliation. This is the reason for environmental factors are - erroneously - often not being recognized as distinct causes of conflict. Since traditional conflict analysis mostly concentrates on tangible protagonists of the struggle. On the other hand, there are examples in traditional societies where an intimate connection exists between ethnic affiliation and patterns of resource utilization. For example, the typical ethnic cleavage between settled farmers and nomadic pastoralists prevailing in transitional zones is often caused by their distinct forms of subsistence. Here, the channels of conflict often can directly be traced back to competing patterns of resource use (Bächler 1994b; Suliman 1992).

But this is not generally the case in the Jordan Basin region. Water, as well as other environmental concerns, simply does not have any noteworthy connection to the channels within which the Arab-Israeli conflict is being and has been fought out. The struggle is between historically grown national movements and states. These are also characterized by distinct cultures and religions. In our case, these channels of conflict must be regarded as originary and having a strong dynamic of their own.

7.4 Has water been a *catalyst* of conflict and violence in the Jordan Basin region?

In the history of the Arab-Israeli conflict, water's role as a catalyst of conflict has not been particularly pronounced. The dynamic and intensity of the struggle has been mainly determined by political actions on the ground, such as terrorist attacks, land expropriations, troop transfers, etc., and by greater developments in world politics. Undeniably, at repeated occasions, water has been involved as a strategic goal, a means of pressure, or a military target (see above). But here again, these involvements must first be seen in the context of political core issues of the Arab-Israeli conflict. Until now, water has been included in the dynamic of conflict mainly as an intervening variable, rather than as a catalyst in itself.

This was the case because the historical conflict overwhelmingly dominated the scene and because the hydrological situation still left some room for development. With consumption having reached and even surpassed the limits of natural replenishment, and in light of advancing qualitative deterioration of existing supplies, water increasingly becomes an independent catalyst of conflict. Although improved management might be able to relieve the hydrological crisis for a transitory period (see chapter 4), the physical limitedness of the resources puts objective constraints on socioeconomic development in the region. In the current peace negotiations water has already proved to be a serious obstacle for achieving progress in the political sphere, especially regarding territorial concerns (see chapters 3.2.2 and 3.4.2). If population growth continues at current rates (see Table 2.1) and precipitation patterns possibly decrease as a consequence of climatic change (see chapter 1.8), the hydrological crisis will become a source and trigger of instability and struggle independent of developments in the proper political sphere. In other words, once they become irreversible and produce cumulative negative effects, water scarcity and quality degradation become an exogenous variable that could perpetuate the conflict and change its character.

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