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Israeli-Palestinian Peace Research Project
WORKING PAPER SERIES

No. 20

Water: A Factor for Conflict or Peace in the Middle East

Abdel-Rahman Tamimi

Palestine Hydrology Group
Jerusalem

Winter 1991/92

A cooperative research project supported by the John D. and Catherine T. MacArthur Foundation.

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INTRODUCTION AND BACKGROUND

If the decade of the seventies was the decade of petroleum and the decade of the eighties was the decade of the war (by proxy); then this decade will be the decade of the conflict over the limited water resources in the Middle East.

The origins of the struggle which this paper discusses and sheds light on are obvious from the Euphrates to the Nile; it is most clear in the Occupied Arab Territories (OAT). Based on this, water experts agreed in April of 1989 that the water security in the Arab world is not of less significance than the national or military security. Results derived from research conducted by American research centers in Philadelphia (Pennsylvania) and Washington D.C. indicate that with the increase in the population rate (about 4% in the Middle East) and the decrease in the average amount of water generated in the region; it will be impossible in the decade of the nineties to provide for the water needs of the next generation. The result of this depletion, which Israel has deepened in the Arab world, has intensified due to Israel's stealing whatever it could from rivers and groundwaters to hit the Arab depth. Since we realize that the upcoming war between the two parties will be a civilized war where the struggle over water in the Middle East will become an inevitable struggle where conventional and non-conventional weapons will be used irrespectively.

In 1989, a report by the Strategic Studies Center in Washington D.C. appeared to confirm from anew that a war over the control of water will appear side by side to the Arab-Israeli conflict. And the struggle over who acquires more portions of water shares will be the main characteristic of this struggle. Perhaps this explains the secret to the intricate coordination academically and politically between the United States and Israel in the area of water politics or hydropolitics. Something that attracts attention is that Israel, and it is one of the countries that suffer the most from the water shortage, sees in the sources of Arab rivers and Arab surface and ground water a salvation to their problems in the area. Based on this, Israel pays special attention to the Arab basin countries, especially those in which rivers originate.. It foresees itself, for many reasons, as a main player in the water politics of the region. Therefore, Israel may attempt to blackmail the arab position throughout the negotiations in order to achieve water gains. However, Israel safeguards against over emphasizing this for fear of exposing it's own vulnerability and sometimes appears with the facade of cooperation, calling for stability and that is for many reasons particular to Israel, such as:

* Israel participates both directly and indirectly in some of the basins of the arab rivers and she is, in actuality, still in a state of war with these countries.

* The arab capacity to intervene is still effective in the area of water security and therefore it is difficult to use this "card" to threaten the arabs.

* The non-arab basin countries (Turkey and the African countries); their ties with the arab countries are stronger than their ties to Israel.

* Israel's unlimited ambition to become the agricultural, industrial, and tourist country in the region. This is extremely difficult given the limited water resources.

Since the emergence of modern Zionism in the 19th, in particular the 1880's, and the development of it's ideas after the Basille conference of 1897; it started to execute it's policies earnestly to find a national homeland for the Jews in Palestine. A few years hadn't passed before the Jews in Palestine reached 85,000 and owned 418,000 dunums of the most fertile land in Palestine distributed among 44 agricultural settlements of which 24 in the Galilee and the coastal plains, 4 around Al-Aoga river and 16 along the Yaffa-Jerusalem railroad track. The Zionist movement did not suffice with just building settlements but worked to control the water resources in Palestine in reality in cooperation with the British colonial powers. Britain and France's role was obvious in realizing the ambitions of the Zionist's masterplan in laying out the northern and eastern borders of Palestine by encroaching upon adjoining arab land. The objective being to incorporate some of the more important water resources within the borders such as the origins of the Jordan river, Lake Tiberias, and the eastern Jordanian course of the Yarmouk river. And Palestine with these refined borders was placed under British mandate rule as a stepping stone towards implementing the Belfour declaration and the establishment of a national homeland for the Jews.

Among the executive measures that the British mandate government offered the Zionist movement was it's approval in 1927 to open a company founded by the Russian jew, Mr. Benhas Rotenberg, named the Palestine electric company and granting it exclusive privileges to exploit the waters of both the Jordan and Yarmouk rivers at their meeting point - the Al-Majame' Bridge to generate electric power. Among the company's "conditions for commitment" was the ensurance of it's control over the waters of both rivers and the danger of using this water without the company's approval. These conditions were approved and the company established it's facilities and operated till the end of 1948.

Succeeding this privilege was another one allowing for the drying-up of the Al-Hawleh. The beginning of this project started when the Ottoman government granted privileges to a number of Lebanese. By doing this, they revealed the preliminary work and the high costs of this project, estimated at 50,000 Palestinian liras at the time per dunum. The Lebanese had a financial deficit

thus providing the Zionist movement with the opportunity to pressure the government of the British Mandate to transfer the privileges to the founder of the Jewish company, Hakhshart Hayshoob, in 1934. Despite the fact that it obtained the privilege, work on the project didn't start till after the establishment of the state in 1948.

The interest of the Zionist movement in the water resources focused on determining the quantity of water necessary to absorb and settle jewish immigrants. It was for this purpose that the jewish agency in 1937 established Mikaraot company to perform all functions regarding water. This company is the facilitator of the Israeli exploitation of arab water. The study that is put forward, even before the establishment of the state, was conducted in such a manner as to ensure control over water resources and it's exploitation in a well-researched scientific manner. This company still operates within occupied Palestine. As for Israel, control over the water resources remains a significant economic gain acquired through the land it occupied in 1967 and the actual depletion of southern Lebanon. Presently, with the exception of the Litani river, more than half of the overall Israeli consumption is composed of water which was diverted by force from water resources which lie outside the 1967 Israeli borders.

The first water resources which were overtaken by Israel in 1967 were those deriving from the underground water basins in the West Bank. Most of the rainwater which precipitates in the West Bank ends up as groundwater which nurtures land within Israel proper. The Israeli exploitation of these resources began in the early 50's. These underground reservoirs have become an indivisible part of the system devised to extract water then to restore it in wells again along the Ashqelon-Haifa coast.

Israel's unending desire to become a distinguished state (as previously mentioned), the increase in population due to natural growth rates, and the influx of Jewish immigrants has resulted in a situation that Israel can not fulfil the demand even with what it takes from the West Bank and South Lebanon. Therefore it started to propose the idea of taking advantage of waters outside it's borders after exhausting the waters of the Jordan river. The idea started with attempting to convince Egypt to divert 1% of the Nile river under the name "Water Peace Project" to Israel vis-a-vis the Occupied Territories. Mr. Elisha Kally, former head of the long range planning division in Tahal (Israeli company) proposed this idea and after outlining this idea it will become evident that it no more than an attempt to revive an old Zionist plan which was submitted to the British Mandate authorities in 1922.

A study of the water resources in Palestine is considered to be the best example which reveals the strong bond between the political and water conditions in the region. In particular, between military expansionalism and Israeli strategies and the

water resources. The primary goal behind Israeli expansion in Palestine, the Sinai, Golan, and South Lebanon is to take control of water resources. These resources represent the weak link in the Israeli geo-political composition on the one hand and between it being a source of ideological animosity on the other hand.

American Water Plans After 1948

The confrontation between Israel and the Arab countries occurred after the declaration of the State of Israel in 1948. This was succeeded by numerous water projects aimed at solving the water problem. The more significant projects are:

1. The McDonald Plan of 1951

This plan was formulated by Mr. Murdoch McDonald and embodied four stages in order to utilize the Jordan River and it's tributaries. The Arabs's had reservations about this project for many reasons. One of which their rejection of the idea of using Lake Tiberies as a storage reservoir which Israel had control over. In addition to the fact that surface evaporation would result in the loss of a large portion of water.

2. The Banger Plan of 1952

Mr. Miles Banger, an American expert, devised this plan. This plan came to compliment the McDonald plan and emphasized the necessity of incorporating the Jordan River. The more important points in this plan are:

a. Construct two dams on the Yarmouk River
b. Divert water from the two dams to irrigate the eastern and western Ghor valley

Israel refused this plan and the American government pressured UNRWA and the fourth point (military post) was withdrawn and the plan ended in failure.

3. The Baker and Herza Plan of 1955

The two companies of Baker and Herza conducted a study to utilize the Jordan River which lasted for eighteen months. The findings of the study came to reconfirm Banger's proposal to build the dams.

4. The Johnston Plan of 1953 - 1955

The American president Eisenhower's representative in the region tried to bring together between the Arab and Israeli stands concerning the Jordan River. The political conditions at the time were favorable, allowing for agreement. America also aimed from this agreement of joint use of the natural resources to lead to the

recognition of Israel by the Arab side.

5. The Meen Plan of 1953

This project relied on the results of the formerly mentioned projects. This project relied on the projects which agree with the Israeli point of view such as:

a. Converting Lake Tiberies into the main water storage reservoir of the Yarmouk River.
b. Utilizing the water of the Jordan River Basin
c. Establishing a dam on the Hasbani River (lebanon) and diverting the excess to Israel.

This plan was rejected by the Arab side.

6. The Kuton Plan of 1954-1955

This plan was merely an Israeli response to the Meen plan and the Johnston plan. The Israeli's clearly expressed in their response their water ambitions and revealed the basis on which their water policies was founded such as:

a. Lake Tiberies is to be the main water storage reservoir of the Yarmouk River
b. Developing of all water resources in the region jointly
c. Connecting the Dead Sea with the Mediterranean Sea vis-a-vis a channel
d. Projects will be conducted under Israeli supervision
e. Coordination between the countries to utilize the water basins.

These are but a few of the water thoughts through which the United States aimed to execute it's policies in the region. History is repeating itself and the United States is trying to play the primary role to simultaneously solve the water and political crisis. But, what in actuality is the problem and it's ramifications after an occupation of the West Bank and Gaza Strip of about a quarter of century?

DIMENSIONS OF THE PROBLEM IN THE WEST BANK, GAZA STRIP, ISRAEL and NEIGHBORING COUNTRIES

Each of these will be examined separately.

The WEST BANK

In light of the geographic importance of this area in resolving a fraction of the political and military struggle, concentration here will only be on the hydrological context. Especially since the political and scientific Israeli circles

consider this area an indivisible part of their water security and this is for numerous reasons.

Israel obtains approximately 40% of it's water needs from the waters of the Occupied Arab Territories (OAT) in the West Bank and Gaza Strip. In addition to another 40% to serve the Israeli settlements within the OAT. Thomas Naff, an expert in Middle East water issues, affirmed in an article in the Washington Post based on his famous research study that Israel can no longer continue to deny that the waters of the West Bank are an indivisible part of their overall water consumption. The Military Authorities has placed strict rule for the use of water by Arabs. On 15/8/1967 the military authority issued military order number 92 "Order Concerning Powers for the Purpose of the Water Provisions" under which the military governor was granted unlimited power to regulate Arab water consumption in addition to inflict punishment or fines on those who he views as violators. In 1982 the water resources of the West Bank were completely incorporated into the Israeli water company, Mikarot.

As an outcome of these Orders, Arabs were prohibited from drilling new wells without a license from the military governor. Throughout the past 22 years, the occupation authorities have not permitted the drilling of any wells for agricultural purposes and only a few for drinking purposes. Generally speaking, Arab wells can not exceed a depth of 140 meters whereas the Israeli wells reach a depth of over 800 meters. Due to these policies, a number of Palestinian wells have gone dry and/or the percentage of salinity increased. In the West Bank there is not a single settlement or military post without a water network system, whereas 51% of the Palestinian villages lack this facility. The following table shows the number of villages in the West Bank which have an internal water network suitable for drinking.

Table 1 : Village Water Networks[1]

AREA	VILLAGES OR TOWNS WITH WATER NETWORKS	TOTAL NUMBER OF VILLAGES AND TOWNS
Jenin & Toubass	20	95
Tulkarm & Qalquilia	19	47
Nablus	54	99
Ramallah	65	72
Jerusalem	32	35
Bethlehem	27	31
Jericho & Hebron		

[1] Data gathered up to 1989

The Arabs are subjected to a harsh form of discriminatory measures concerning water use in the OAT. The Israeli settlements consumes more than five times the amount of Arab consumption. In addition, the arab consumer pays two times what the settler pays for the same quantity of water.

Water Budget in the West Bank in Terms of the Hydrological Context:

The average annual rainfall in the West Bank ranges between 500 - 600 millimeters. The average number of days in which rain falls is 50 and the daily evaporation loss is 7 millimeters.

Groundwater movement in the West bank has two primary directions, eastward and westward separated by a line. It starts in the south at Dahiriya passing through the hills of Ramallah and ending up in the Jenin area (north).

The basins and their direction : As can be seen in Figure ?, there are small water basins in the West Bank divided according to the movement of water in it. The Western basins includes the Al-Timsah basin and the Hebron- Beer Sheva basin. The Northern basins include the Nablus-Jenin-Jalboa Basin. The Eastern Basins include Bardala, Al-Farqa, Al-Maleh, Al-Baqua'a, Fasaiyel, Al-Aoja, Ramallah, Jerusalem, South Jerusalem basins.

The Water Budget :

Average Rainfall = 500 mm x 5572 km^2 x 1000
= 2,800 million cubic meters (mcm)
Evaporation Amount = 7 mm x 50 x 5572 x 1000
= 1,900 mcm
Surface and valley waters = 176 mcm/year
Groundwater = 724 mcm

As for the consumption budget, they are only estimated quantities but nevertheless reveal the negligence towards the Palestinian Arab rights. The following tables show how the Israeli's are benefitting from the waters of the West Bank both directly and indirectly.

Table 2 : Water Usage
Table 2.A. Arab Consumption

SECTOR	CONSUMPTION, MCM/year
Agriculture	95 - 100
Industry & Drinking	15 - 20
Total	110 - 120

Table 2.B. Israeli, direct and indirect, consumption of West Bank

SECTOR	CONSUMPTION, MCM/YEAR
Water Flowing Westward	470
Settlements Irrigation Drinking & Services	 53 12
Total	535

The overall Arab and Israeli consumption ranges between 645 - 655 mcm. The water excess in the West Bank (total available - consumption) is about 200 mcm under ideal circumstances. Therefore talk of there being a water storage in the West Bank is not accurate and is fabricated for political purposes and to draw attention away from the Israeli theft of this water. In addition to securing this water reserve as part of the Israeli water reserve. Under the worst conditions, there is a surplus of 140 mcm of West Bank reserve.

The GAZA STRIP

The Gaza Strip is inhabited by approximately 900,000 people living on an area of estimated at 360 km^2; the Strip has a length of 41 km and a width of about 8 km. The demographic and economic crisis of the Strip increased in 1967 due to the imposition of occupation, because this occupation led to the fleeing of thousands. This was further complicated by the fact that thousands of dunums were seized by the settlers (look at the attached table) which resulted in a demographic and geographic disorder in the Strip.

The Gaza Strip suffers from numerous water problems in terms of both quantity and quality simultaneously. There are salinity problems, caused by the upper layers and sea water intrusion (between zero to 30 meters). There is also saline water in the lower layers (20 to 50 meters) the source of which is geographically the desert lands. Salinity encroachment from the south and east. In addition, there is a lowering of the water table by about 12 mm/year due to the high pumping levels. However, the primary cause of the Strip's water problem is the diverting of the Strip's fresh water which feeds the Strip by extension dams along the length of the Gaza valley.

The average rainfall varies according to the geography and fluctuates yearly. The following table shows the average rainfall quantities in the Gaza Strip.

Table 3 : Average Rainfall

REGION	AREA, Km^2	RAINWATER, mm
North Gaza	67.6	400
Gaza City	61.6	378
Gaza Center	67.9	300
Khan Younis	82.7	250
Rafah	80.0	200

As for the estimates of the water needs for drinking purposes in the Gaza Strip. The following table shows the required quantities for this purpose.

Table 4 : Water Quantities*

YEAR	POPULATION[a] (thousands)			TOTAL	WATER NEEDS MCM/YEAR[1]		
	Arab	Refugee	Settler		75	100	125
1922	29	-	-	29	1	1	1
1931	50	-	-	50	1	2	2
1946	75	-	-	75	2	3	3
1947	85	-	-	85	2	3	4
1948	170	90	-	260	7	9	12
1967	125	200	-	325	8	12	15
1979	-	-	-	405	11	15	18
1987	260	370	2	630	17	23	29
1990	265	485	3	750	21	27	34
2000	275	685	20	980	27	36	45

* Source: UNRWA 1988 - DGIS 1990
1 Consumption litre/individual/ day
a Average growth rate is 2.5% for the period between 1990-2000

As for the agricultural consumption, it is as follows based on agricultural product consumption:

Citruses	1000 m^3/dunum/year
Strawberry	1000 m^3/dunum/year
Vegetables	700 m^3/dunum/year
Olives &	300 m^3/dunum/year

Almonds

The following table shows acreage according to usage in the Strip.

Table 5 : Land Usage

Type of Usage	Area, dunum 1000 x dunum	Area, dunum 1000 x dunum
Housing Land	-	56.5
Settlements	-	37.0
Agricultural Land Irrigated Land Non-Irrigated	 110 58	168
Sand Dunes	-	103
Total		365

The land distribution for agriculture is as follows:

Table 6: Agricultural Land Distribution

TYPE	AREA*	IRRIGATED LAND*	CONSUMPTION, MCM
Citrus	65	65	65
Vegetables	48	28	20
Grains	36	15.5	11
Fruit Trees	45	-	-
Other	24	-	-
Total	225.5	108.5	96

* IN THOUSANDS OF DUNUMS

JORDAN

In mid-1985, the consumption in Jordan reached 870 mcm and it is estimated by Prof. Thomas Naff of the University of Pennsylvania to reach one milliard by the year 2000. This implies an annual water deficit ranging between 170 to 200 mcm. As for the Jordan River which begins in the Syrian and Lebanese heights contains 1,287 mcm and its main tributary is the Yarmouk river. The Jordan river is the natural divider between Syria and Jordan and also divides between Jordan and Israel. Currently only three countries benefit from the waters of the Jordan River; whereas the rights of the Palestinian people continue to be neglected.

Evidence gathered by the West's research centers indicates that the Jordan River basin faces a severe crisis by the year 2000. Israel's needs will have increased by 30% from what it is now whereas Jordan will face a shortage of up to 20%. This is at a time when the upper portion of the river is being used to it's limit. Hence, if the "Unity Dam" between Syria and Jordan is constructed on the Yarmouk river it too will be used to the limit. Most water politics experts agree that by the year 1994, both Israel and Jordan would have exhausted their water resources and truly found themselves in a crisis if both parties don't agree on how to regulate usage. This crisis can only escalate if Syria persists with her developmental projects on the upper Yarmouk. All this will lead to an increase in the salinity in the lower Yarmouk river, Jordan River and Dead Sea. Thus in its part will lead to lower production levels in Jordan and in lower quantities reaching Israel from this water which will lead to more tension between these countries.

SYRIA

Syria will face a water crisis by the year 2000 estimated at one billion mcm if the consumption level stays as it is. This shortage is accumulating due to the low levels of the Euphrates River and the increase in contamination of the river by industrial by-products. Due to this some Syrian towns, such as Damascus and Halab, suffer from severe water shortages in the summer. The Syrian government since 1988 has focused on establishing water projects and dams, consuming 43% of the Government's investments in the budget.

The following table shows the development in water use between 1979 and 1983

Table 7 : Syrian Water Development

CATEGORY	1979	1981	1983
Agriculture	5394	5668	5798
Industry	70	85	85
Drinking	284	359	358
Others	26	31	36
Total	5774	6143	6277

The Euphrates River constitutes the major sources of water for Syria. The entrapment of this water in 1990 in Turkey caused a severe problem to the Syrian agricultural economy. Based on this Syria realized the importance of reaching an international

agreement which will ensure sources of water unaffected by political fluctuations. Syria realizes that preventing water from reaching her will result in a catastrophe. Therefore, water stability in the region is the cornerstone for political security in the region. Hence talk of the "Peace Pipes" project is of great interest to Turkey and Syria.

EGYPT

The drought which affected the Ethiopian stream of the Nile river for many continuous years, resulting in a reduction in the quantity of water reaching the Aswan Dam from 1979/80 to 1986/87, had a great effect on the Nile. Egypt heavily depends on the Nile River. In fact some authors in geographic politics relate between the type of government in Egypt and the fact that it is a basin state which requires a strong, central authority. Among these authors is the German Karl Wood Fogel. The problems which may occur at the head of the River ultimately leads to similar problems at its outlet which affects the increasing internal needs in Egypt for water to generate electricity at the Aswan reservoir.

The American expert in Egyptian affairs, Mr. John Waterbury, estimated Egypt's need of water at 73 billion cubic meters by the year 2000. Given that Egypt has an average yearly supply of water of 69 billion cubic meters, then it will face a water deficit by the end of the century due to rise in unmonitored consumption and contamination of the available water resources.

Egypt has the ambition of reclaiming 2.8 million fadan by the year 2000. As the Egyptian researcher, Mr. Zuhra, stated that these ambition requires 17 billion cubic meters. Hence, Egypt is in need of every drop and aims at increasing it's share of the Nile River; therefore, it is in favor of a regional water solution. This will effect the future mode of cooperation as we will explain later concerning the alternatives to the water crisis. Especially since Egypt does have exclusive rights to the Nile and it is bound by the 1959 Agreement signed by the Nile basin countries.

The Development of the Israeli and Palestinian Water Needs in Light of the Current Needs and Political Changes

A. Israel

Research of the Israeli water consumption faces difficulty, similar to those which face the water resources themselves. That is because the researcher has to rely primarily on Israeli statistics, or information disseminated by the Ministry of Agriculture or the Water Department. There are no other information centers, not even on the West Bank and Gaza Strip where there is no up to date statistics expect that which was collected by PHG.

Before discussing water consumption in the various economic

sectors, we want to outline in the following table the water consumption trend within Israel since 1948 to 1989.

Table 9 : Israeli Water Trend

YEAR	1948/ 49	1953/ 54	1963/ 64	1973/ 74	1981/ 82	1985/ 86	1988/ 89
TOTAL, MCM	230	850	1288	1565	1770	1951	2500

As can be deduced from the Table, since 1948 till 1989 there has been an average yearly increase in consumption of 56 mcm.

With the commencing of the implementation of the seven year plan 1953/1960, the amount of water consumption within Israel had reached 850 mcm, or an increase of 269.5% since 1948/49. Water consumption since 1980 has been relatively stable (in comparison to the increase in previous years). This means that there have been no new water sources to utilize and this contradicts the evidence which indicates that Israel has been using the Litani river. Therefore, Israel has deliberately issued inaccurate statistics concerning water consumption so as to mislead public opinion.

Agriculture constitutes the major water consumption sector, using about 75% of the overall total. Where 400 agricultural settlements were established between the period 1949-1955, and the area of agricultural land increased from 1.65 million dunums to 3.6 million dunums. In addition, between 1965-1972 the number of agricultural settlements increased in the following manner; 228 Kibbutz, 349 Moshavs (cooperatives), and 104 agricultural towns.

Comparison between the increase in water consumption for agriculture and the growth in irrigated agricultural land, we note that the latter decreased (irrigated land) with respect to the former. Hence, irrigated land increased by a percentage of 321% between 1949 and 1979, as compared to 590% increase in water consumption for the same period. This clearly indicates that the increase in agricultural water consumption did not result in the horizontal expansion in agriculture only but also in the direction of cultivating plants which require greater amounts of water such as cotton and sugar cane.

It remains to be said that the Kibbutz's and other collectives are the major users of this water. The cooperatives consume around 44% of the agricultural water whereas the arab villages within Israel use only 2.2% of the water allocated for all sectors. This is despite the fact that the arabs constitute about 15% of the population within Israel (arabs within the Greenline).

Domestic water use within Israel increases by a percentage

comparable to the population growth rate which ranges between 2.1 to 3% between the period 1948 and 1984. Israeli domestic use is about 160 cubic meters (as compared to 15 cubic meters for the arab inhabitants of the West Bank and Gaza Strip).

It can be said that the domestic and industrial use is about 20 - 22% of the total Israeli water consumption.

Generally speaking, the Israeli circles believe that the upcoming period will experience a large water demand by the cities which will result in a reduction of allocated water to agriculture and industry. This will result in a change in the social and economic structure, especially in the Kibbutz. In addition, it could affect the population distribution. The Israeli expert, Shuval Hillel from the Hebrew University, expects that the deficit will reach 350-400 mcm. Another expert, Meir Kotler, in an article in the Ha'artz newspaper 5/6/1978 estimated the deficit at 200 mcm.

Since the water sources within Israel are limited and completely utilized, it will have to pursue different policies and techniques either from within or outside Israel or to think of regional solutions.

B. The Occupied Arab Territories (OAT)

Estimation of the water consumption within the O.A.T. is very difficult due to the dependence of the inhabitants on numerous sources for water such as springs, wells, collection tanks, and valleys and the dependence of these on the rainfall. The Jordanian Authorities estimated the West Bank consumption in 1967 at 81.5 mcm annually and the Israeli authorities estimated it at 110 mcm annually. However, Israeli estimates did not cite that the cause of this increase is due to the presence of Israeli settlements. The data gathered by members of PHG indicate that the average Palestinian consumption is 100 mcm for all purposes. This implies that the average individual portion is around 142 cubic meters for all purposes as compared to 537 cubic meters for the Israeli individual.

Generally speaking, the percent of irrigated land in the West Bank is only about 3.9% of the total cultivated land, whereas this percentage reaches 48% within Israel.

As for domestic use, the number of drinking water wells in the West Bank is around 32 with a total production of 20 mcm. Some drinking water is available from the collection wells.

The agricultural and domestic consumption in the Gaza Strip is estimated at 100 mcm for agriculture and 13 mcm for drinking purposes, under optimal conditions.

Future Water Consumption Estimates

As previously noted, present and future water estimates is part of the overall political struggle. However, scientific data indicates that Israel will unquestionably face a true water crisis in the near future. And will this crisis be at the expense of arab waters (in the O.A.T. or neighboring countries)? The proposed solution to this crisis depends directly on the type of upcoming solution where water will serve as the spinal cord.

The following table shows that the West bank, Gaza Strip and Israel will face a severe and dangerous crisis. However, the West Bank and Gaza Strip face this problem due to the Israeli water policies whereas Israel faces this due to its extreme, unlimited ambition. The numbers show that the West Bank and Gaza Strip will suffer from a deficit of about 120 mcm for agriculture. In addition the inhabitants of the Strip will suffer from a 70 mcm deficit in drinking water. It will be shown later that both these areas will not face a crisis if the Israeli authorities withdrew it's control over the water resources, especially in the West Bank.

Table 10 : Data on Population and Water

ITEM	ISRAEL	WEST BANK	GAZA
1989 population in millions [1]	4.5	0.9	0.6
Future population forecast as of 2005 in millions	6.8[2]	1.9[3]	1.1[3]
Present non-agricultural consumption, mcm/year	500	25	15
Future non-agricultural consumption, mcm/year	1040	190	110
Present irrigation water consumption, mcm/year	1300	100	135
Future irrigation water demand, mcm/year[4]	2500	350	140
Local fresh water resources, mcm/year	1800	120	60*
Fresh water available for irrigation(#7-#4), mcm/year	760	-70	-50
Possible irrigation supply by reclaimed sewage water (half of #4)	520	95	55
Possible water shortage (#6-#8-#9) mcm/year[5]	1220	325	135

Possible shortage of non-agricultural water (#7-#4, if negative[6]	-	70

[1] Central Bureau of Statistics (CBS) Data
[2] CBS data and net immigration of one million
[3] Following S. Bahiri, "Alternative Economic Scenarios for the West Bank and Gaza Strip
[4] By arable land
[5] May be regarded as upper limit of importation demand
[6] May be regarded as lower limit of importation demand
[7] E. Kally, March 1990
[8] Tamimi, A., July 1990 - Palestinian estimates
* Water Resources under occupation

Future Prospects for the Solution of the Water Crisis in the Middle East

It is difficult to discuss a fundamental solution to the water crisis in the Middle East without discussion of a comprehensive political solution to the Arab-Israeli struggle. Issues of water and land have to be included within such a framework. Prior to discussing future alternatives, we must first mention the Israeli ambitions and their approach towards arab water and the present Palestinian perspective of this problem.

A. Israeli Stand

Israel pursues an unusual approach with her surrounding arab countries with respect to water. On one hand, it aims at forcing the arab countries to recognize it at the bi-lateral negotiation tables on the issue of water. Proposal after proposal is submitted in order to utilize Arab water. Due to the limited budget to conduct studies on the larger rivers; most research is conducted on Israel's behalf by Western, especially American, research centers. Examples of this are numerous, such as the Johnston plan (previously mentioned) and studies by the Strategic Studies Center in Washington D.C. As a result of the cold war between America and Egypt in 1964, the United States concluded a study about the waters of the Nile River which it provided to Ethiopia in order to reclaim 400,000 hectares of the land falling on the border between Sudan and Ethiopia and generate energy. Realization of such a project would result in both Sudan and Egypt loosing at least five milliard cubic meters.

Israel has ambitions in the Nile river since the beginning of the century. With the increase of it's sensitivity of the inevitability of a water crisis, Israel accelerated to cooperate and coordinate with the United States in the area of water research. And for reasons still unknown, the Israeli research departments view the waters of the Nile river as the key to the water problem within Israel. It is for this reason that it pays special attention to both Egypt and Ethiopia. Israel sees in itself as playing a major role in this area due to it's possession of advanced technology which others do not have.

Numerous articles appeared in the Israeli media proposing the diversion of water from the Nile to the Negev. In Ma'arev newspaper 27/9/1978 there was an article calling for this. The Israeli expert, Elisha Kally who headed the long term planning division in Tahal, examined this project and backed it up with numbers and costs and named it the "Peace project". [It is known that Tahal is scrutinizing the costs of this project in detail]. Discussion of this project will be given later.

A similar project was submitted by an Israeli researcher at the Armond Hammer conference in 1987 held at the Tel-Aviv university. It was proposed that water be transferred from the Nile via Sinai to the Gaza Strip and Negev.

The Israeli ambitions in the Litani River have been in existence since a very long time. The Zionist movement tried to persuade the Allied forces to modify the borders of Palestine so as to include the Litani River. In 1941, the Jewish company submitted to the Lebanese president, Alfred Nakash, a proposal requesting the privilege to utilize the waters of Lebanon including the Litani by providing Lebanon with the water and electricity and to transport the excess to Israeli settlements. In 1954/1955 the Litani river was interjected into the Kuton plan which proposed the transfer of some of it's water to the Jordan valley. When Israel occupied the south of Lebanon, several studies indicate, that Israel started diverting water at the Khardaly bridge via four pumps in a pipe to the Jordan valley via Al-Hasbani. There is also evidence which indicates that Israel is working on diverting the Litani river by constructing a 17 kilometer underground tunnel from a point that lies on the south of the Khardaly bridge at an elevation of 239 meters to a location in the Houleh plain at an elevation of 200 meters where it hooks up with a channel which transports water from the Wazani springs and from there the water is transported to an elevation of 44 meters in an area overlooking Lake Tiberies without passing through it to the National Water Carrier (regional project).

As for the Israeli perspective towards the Jordan river, it is no longer a mere idea but has become a reality because Israel is utilizing most of it's water and prevents arab inhabitants of using any portion of it under the pretext of security. Israel removes water from the river to the western areas through the national water carrier. In addition to this, Israel obtains around 100 mcm from the waters of the Yarmouk river. The total Israeli consumption from the Jordan river and it's tributaries is about 600 mcm.

B. The Palestinian Perspective

The water problem in Palestine (occupied territories) arises from two equally significant sources which can be summarized in; (1) the geography and geology of the O.A.T., where Israel shares in

portions of these water basins on the western side of the West Bank and ; (2) the Israeli water policies implemented on the O.A.T since 1967 and which relays fundamentally on the first source. As previously mentioned Israeli water policies also incorporated control and supervision of water consumption. This policy of control is especially blatant in the practice of regulating the quantities of water allocated to Palestinians. We must keep in mind that while Israel claims that it has exhausted the water reserve and that the water reserve in the O.A.T. is threatened by depletion and uses this excuse to justify it's refusal to grant permits to drill wells, Israel continues to drill wells to serve the Israeli settlements within the West Bank.

The Palestinians perceive the deep wells that Israel bored along the extension of the Greenline as accelerating the flow of water towards the water basins within Israel in addition to natural gravitational flow. This is all at the expense of the groundwater supply of the northern West Bank. With respect to the Gaza Strip, there are a number of dams erected right outside the Strip which aid in intensifying the Strip's water problems and results in insufficient recharge of the underground water of the Strip's water basins.

These issues and facts are what compose the Palestinian solution alternative (which will be discussed later).

Alternatives to Solve the Water Crisis in the Occupied Arab Territories, Israel and Neighboring Countries

Talk of possible solutions to the water crisis in the region focuses on three main tracks which will be presented in detail. Then there is the last alternative which is the continuation of the occupation and its dangers.

TRACK 1 : Resolution of crisis between two countries, Israel and Palestine with no regional cooperation

Of the outstanding characteristics of the water crisis in the Middle East, is the use of water as an element of pressure to solve other problems. In the event of negotiations, the following must be concentrated on:

1. The strategical water confrontation between Israel and Palestine depends on the nature of the overall peaceful solution given that water is an indivisible aspect of the legitimate Palestinian rights.

2. The status of the exploitation of the Jordan river is illegal whereby Israel continues to deplete the Rivers water through illegal ways.

3. Consideration of the Johnston plan as a starting point for any negotiations is unacceptable because this plan negates the Occupied Territories of its independent political identity.

4. Consultations must be conducted with the Arab parties and Israel to affirm the Palestinian rights in the Yarmouk river since it is a tributary of the Jordan river. This right has been neglected in all projects which benefit from this river.

5. In the case of groundwater, all countries have the right to pump water from the ground which falls within it's territory on the condition that this pumping does not affect the surrounding countries. This is the opinion under general international law. In addition, this is an issue which has to be organized by international agreements which specify the amount of water which any country is entitled to pump. This principle must be applicable to the shared Palestinian basins.

Based on the above, the Palestinian-Israeli solution to the problem must focus on the following:

1. That all parties recognize that the future Palestinian state has the right to negotiate, on the same footing, and to reach regional agreements about the sharing of the Jordan river and it's tributaries.

2. That the Palestinian entity has the right to demand it's water portion and to reach an agreement with the Israeli side about compensation for the water the Palestinians have been deprived of or stolen since 1967.

3. The necessity to require the Israeli side to reveal the numbers and scientific facts relating to water in the O.A.T. and about the artesian wells bored along the extension of the Greenline on the Israeli side.

We must make sure that based on the Helsinki Agreements of 1966 and United Nation's agreement of 1972, water portions are divided according to population taking into account the historical rights.

After ensuring the above mentioned Palestinian rights, the Palestinian political leadership may find it appropriate to pursue regional cooperation between the countries of the region on water issues. Thus the problem will be faced by a larger group characterized by joint projects. However, the Palestinian side must realize that the West Bank, in particular, is among the least geographic regions in need of such projects and to emphasize that Israel is the number one country which is in need of finding a way out of this problem. It is inevitable that there has to be some type of regional cooperation, but only after establishing the Palestinian rights.

TRACK 2 : Limited Regional Cooperation to Solve the Crisis

In the beginning we must mention that by regional cooperation it does not, in any way or manner, imply projects of political or economic integration. It means conducting joint water projects where water percentages and benefits are determined by agreements. Limited regional cooperation implies cooperation between Israel, Lebanon, Jordan, Syria and Palestine to divide the waters of the Jordan and Yarmouk rivers on the one hand; and, between Israel and Palestine to solve the problem of the joint aquifers on the other hand. In the area of limited regional cooperation, we must mention the Johnston plan.

The Johnston plan was not merely a water project but was also a part of the American policy in the region. Despite the fact that the Johnston plan may provide wide guidelines to share the Jordan river and it limited portions for each party (excluding the Palestinians); it's primary objective was to encourage cooperation to confront the surge of socialism and the development of nationalistic sentiments at that time in addition to establishing some minor projects to "sooth" the Palestinian refugees. Johnston suggested the following percentages:

Jordan	49.6%
Israel	38.9%
Syria	9.1%
Lebanon	2.4%

The Palestinian portion was not clearly stated at the time. Therefore, in light of this limited cooperation these percentages will be re-examined. afterwhich other water projects can be established such as:

1. Dams on the Yarmouk river with the ensurance of all party's rights
2. Technological projects funded by international cooperation such as Desalination projects and solar energy projects in water projects
3. Establishing a Jordan river committee composed of all projects to oversee and manage joint projects. There are numerous examples of such bodies such as the "Organization for the Management and Development of the Ka'gera basin river (Tanzania, Uganda, Rawanda, Burundi) and the "Gambia River Organization" (Guinea, Senegal, Gambia, Guinea Bisaw) and the "Mano River Union" (Sierra Leone, Liberia, New Guinea).

TRACK 3 : Extended Regional Cooperation with International Support for Large Projects

Prior to discussing an extended regional cooperation, we must reaffirm that solving the water crisis is the ambition and goal of all parties regardless of the extent to which they suffer.

The area that arouses much debate about the Middle East water crisis is which comes first the economic or political factors and which is the independent variable and which is the dependant variable. Some opinions state that the political problems which have evolved are a result of the economic dimensions represented by irrigation, agricultural, and energy projects. While others see that the political problems in the region have resulted in fears that one party will threaten the water resources of another. This has led to parties constructing dams to protect their waters.

The truth of the matter is that we lean towards the point of view that states that the water problem is not a technical one but has economic and political dimensions. The truth of the economic aspect to the water crisis can be seen by looking at the struggle between riparian countries. The best example of this is the status of the Nile basin where Ethiopia and Upper riparian countries continue to establish projects which affect Egypt and Sudan. As for the political dimension, it is the Israeli exploitation of the West Bank waters in an attempt to evacuate the land and because it is easy to take control over. Water experts state that the major cause of this water crisis is the population explosion which has exhausted the available resources. If joint projects are not implemented and the political and regional situation is not resolved; there can not be a comprehensive solution to the water crisis.

As for the future, experts warn from the lack of any comprehensive solution in dealing with the water crisis. Desalination of sea water for large scale irrigation is a very expensive alternative. As for other technological alternatives such as agriculture that requires less water; this is feasible but they do not agree with our nutritional demand.

The overriding probability is that the conflicts over water will serve to feed the regional tension. This is for three main reasons which are:

1. Fifteen countries are fighting over the region's diminishing water supply.
2. The fact that none of the basins are subjects of comprehensive agreements.
3. International law has not provided a clear basis for solving the water crisis.

Owing to the fact that economic and political factors have entered into the water problem in the Middle East in light of there not being a legal framework binding the parties, the severity of this problem increased. Therefore, examination of means to combat this problem must take into account the following criteria:

The strategical approach for confronting this crisis depends on the nature of the applicable scenario to the crisis. These

can be classified in two categories, one of which is of a confrontational nature and the other is of a cooperative nature. The latter implies establishing joint projects to prepare for the forthcoming problem which will effect all countries of the region. The emphasis here will be on this latter approach. In what follows is a presentation of such joint projects.

A. The Egyptian Alternative

There was a proposal for taking a fraction of the Nile river water to Israel and the West Bank vis-a-vis the Sinai, in return the West Bank would take water from Lake Tiberies. This project was referred to by the Israeli media towards the end of the seventies and was published in a book by Dr. Elisha Kally, former long range planner in Tahal.

However the present situation in Egypt does not allow for the implementation of this project. This is because the total water sources in Egypt are 61.5 milliard cubic meters, of which 55.5 milliard cubic meters is from the Nile. Egypt has a plan to reclaim 2.8 million fadan by the year 2000. Therefore, the deficit in the amount of water required to reclaim this land is 14 milliard cubic meters. Despite these facts, Egypt needs every drop of water. In addition, there is official and popular objection to this project as well as the fact that Egypt can not unilaterally decide on the Nile River. This project, however, may succeed under the following conditions:

1. Realizing a just peace in the region which would create trust in establishing large projects
2. Ensuring international financial support for this project thereby using all parties in one way or another
3. That this project be within the framework of an overall political resolution in the region.

B. The Jordanian Alternative

This alternative has deep seeded historical roots and has been a political problem from the beginning. This has been a source of conflict in international councils between Israel and Jordan, in addition to being a source of interest for the American administration. In 1953 there was a project by the representative of President Eisenhower to the Middle East to propose a regional solution. And in 1966, the technical committee of the Arab League concluded it plan to utilize the waters of the Jordan river tributaries for the benefit of Jordan, Lebanon, and Syria.

As with Egypt, Jordan suffers from a severe water deficit and land reclamation requires alot of water which will make Jordan hold onto any portion of water. Therefore, nothing will benefit Jordan except for international cooperation and joint projects. One of the feasible projects from a technical point of view for regional

cooperation and international financial support is to construct a channel between the Yarmouk river (which constitutes the border between Syria and Jordan, and Israel and Jordan) and the Houleh lake (the geographic location for this lake). During the winter months, this channel will transport water which will otherwise go unutilized to the lake and some this water can feed the water layers in Israel and the West Bank. During the dry seasons, this water can be re-pumped through the Yarmouk river to the Ghor canal which irrigates the Jordanian side of the Jordan river. This solution could be an example of possible regional cooperation; however, it needs international funding and regional cooperation under an international umbrella.

C. The Lebanese Alternative

The Litani River has been an Israeli strategic objective for a very long time and one the Israeli's feel that they can take over. From the Israeli perspective, this river adds at least 800 mcm annually to the Israeli water resources or about 50% of this vital resource. The closest point from the origin of the Litani falls at a point two to three kilometers from the Mattaleh on the Israeli northern border. Israel sees that it can, in practice, divert the waters of the Litani through a two to three kilometer tunnel connecting the Litani to the higher portion of the Jordan river and from there to the National Water Carrier. The ideal place to obtain the water is from a location which falls on the existing Al-Haly Dam at the Karoun Lake; this implies total control over half of the southern Bika'a valley.

This project requires pre-requirements, such as :

1. Compensate Lebanon for the loss of a great portion of it's fertile land which falls in the Bika'a valley.
2. Ensure the safety and security of southern Lebanon from Israeli greed.
3. Realize the greatest benefit which the Lebanese determine.
4. Necessity of the O.A.T. to benefit from this water.

There was another project prepared by the American representative in 1968, in addition to one prepared by 16 Israeli scientists after conducting a field survey.

Israel's demand in reaching an agreement on the quantities of water from the Litani river must be taken as a pressure card on Israel to force Israel to realize other Lebanese and Arab demands in other areas.

D. The Turkish Alternative

It is known that high level technical experts are participating in water projects in Turkey. In the Center for Strategic and International Studies conference, the high level Turkish

representative revealed the "Peace Pipe" project. The project, as presented by the Turkish representative, entails two large pipelines emerging from the Turkish land. One in the direction of Kuwait, Eastern Saudi Arabia, Bahrain, Qatar, The Arab Emirates, known as the "Eastern Pipeline". The "Western Pipeline" will serve some Turkish towns, Syria, Jordan, O.A.T., Israel and Western Saudi Arabia.

The cost of this project is estimated at 20 milliard dollars which will require the Turkish government to request funding from banks and international organizations. As was mentioned in the Report by the International Center; the main obstacle in the way of this project lies in the benefitting countries and in their participating in it. The report states that the countries must be convinced that the project's economic benefits are far greater than any political compromises which any party would have to make. And that the overall objective is to reduce the conflicts and revive the developmental plans.

The presence of an international umbrella whose role would not just be funding but also in devising long term plans and financing these plans to prevent any side effects from becoming obstacles which will prevent the best utilization of these projects.

In summary, if talk about a war over water or the water crisis which envelops the region of the Middle East and other areas of the world sheds a dismal light on mankind future, then the current technological advancements provide an array of solutions. Among these solutions are the construction of dams to store water and construction of de-salination plants.

Despite this, the region has not been able to reach a unanimous decision to solve the water problems and that is because of Israeli's insistence on benefitting from Arab waters unilaterally. It will be impossible to obtain international financial support or support from the super powers until after not only stability but also realizing a comprehensive and just peace for all people in the region.

General Discussion

The present situation must impose on the researcher to find means to administer these conflicts. Despite the fact that this is a topic for another study, it's realization is a question of great importance. From the scientific perspective, there are but two alternatives which are:

1. Confrontational : This is based on the premise that national water security is indivisible and therefore the Arab countries and the Palestinians must exhaust all international arenas and international balance in favor of terminating the exploitation by

other countries participating in the shared arab waters.

2. Cooperative : This is based on the premise of mutual benefit between strategically located countries or basin countries. This derives from the belief of the existence of shared interests or reciprocal interests without injuring or going beyond the limit. Taking into account the true nature of every riparian needs and it's best utilization. This alternative is the more applicable one because it incorporates shared interests, among others.

The importance of water is escalating due to it's use as a tool in international struggles because of it's political and strategical implications. These implications may result in competition between the countries interested in water. This is especially true since most countries depend in developing their water sources on large scale equipment and structures such as dams. These structures can be, under a state of animosity, easily targeted and destroyed. The case of the Jordan River is a prime example where Israel prevents both Syria and Jordan from implementing it's projects on it and on the Yarmouk river.

At the present time, estimates indicate an increased need for water in Israel, Jordan, and the O.A.T. By the year 1995, the population within Israel, Jordan, and the O.A.T. will reach 5 million, 4 million, and almost 2 million respectively. If we add to these estimates the side effects that the Israeli plan of absorbing 2 million immigrants and providing for their needs will have. Then it becomes obvious that the issue of water distribution and controlling of the water resources will be a decisive factor in navigating the negotiations particular to the establishment of a Palestinian state and returning the Golan heights to Syria.

It remains to be said that Israel will resort to compromises and reviving old projects such as the Johnston plan if negotiations commence. In addition, it will also give and take on alot of projects proposed in the fifties. Therefore the arab side, especially the Palestinians, must tie the solving of the water crisis with the realization of the Arab and Palestinian aspirations. Because Israel suffers the most from the water crisis and it will be the number one benefittor from joint water projects since it will achieve both peace and water simultaneously.

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No. 19

Options for Solving the Palestinian Water Problem in the Context of Regional Peace

Elisha Kally

Business Enterprise Consultants

Winter 1991/92

A cooperative research project supported by the John D. and Catherine T. MacArthur Foundation.

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Options for Solving the Palestinian Water Problem within the Context of a Regional Peace

Elisha Kally

1. Introduction:

This paper deals with water issues as one component of the Israeli-Palestinian conflict which will need to be resolved within the framework of a regional peace.

At the time this paper was written, during December 1991, the prospects for a regional peace arrangement -- and within this an Israeli-Palestinian peace (possibly in the form of an Israeli-Palestinian/Jordanian settlement) -- were changing from a dim hope to a clear and attainable goal. Thus, this study has taken on the character of a needed and even an urgent basis for actual negotiations and future arrangements. The author of this paper is a water engineer who has elaborated much of the material presented in this study (the data, analysis, and proposals) with the support of the Armand Hammer Fund of the University of Tel Aviv. However, the paper reflects the author's personal and professional opinions. In no way does it represent the positions or opinions of any establishment or institution.

It is hoped that the following proposals, as an independent initiative, will attract the attention of the government agencies and other bodies which are in a position to further their implementation. The following story highlights the need for such cooperation. In the Egyptian-Israeli peace agreement of 1979, there was a provision which, at the time, was seen by Israel as an achievement: Egypt was required to sell to Israel the same quantity of oil that Israel previously produced in the Sinai. A few years later, the author witnessed a conversation in which an Israeli economist (from the University of Tel Aviv) asked Egyptian and Israeli diplomats, who had worked on the peace negotiations, why Israel had not demanded that Egypt should purchase an equal value of Israeli products each year. The Egyptian's answer was that "no one even made such a request of us." The Israeli's answer was that "at the time we were so satisfied at having negotiated the oil agreement, we didn't even think about it." The

economist responded, "But I suggested such an arrangement during the negotiations!"

The lesson to be drawn from this story is that the politicians conducting the negotiations do not always have the time to consider each step taken, nor do they always have the time to listen to those who have the time to work through a proposal in detail. What is presented here is written in the hope that it will enjoy a better fate than that of the advice rendered in the above-mentioned example.

The present-day water problems of the Palestinians are of two types:

A. Problems which stem from the geographic, demographic, and hydrological characteristics of the areas with which we are concerned.
B. Problems which stem from the Israeli occupation and control over these areas.

This paper focuses solely upon the first category. Though the second category of problems, including injustices and discriminatory practices regarding water resources, greatly concern the residents of the Territories (sometimes more than the first category of problems at present), the primary difficulties with which an independent or autonomous Palestinian population will have to grapple will be those presented as being within the first category.

This paper deals with the Occupied Territories (OT) as delineated by the "green line," and does not, with respect to water needs, distinguish between Jews and Arabs in these territories.

2. General Background:

2.1 The Region:

Like other infrastructure issues such as transportation, communications, and energy, and in contrast to certain economic and social questions that are relevant to the OT alone, we cannot analyze water problems in the Territories without addressing the region as a whole and

surveying the overall context of the water situation. We will conduct this survey from a number of perspectives:

A. The Geographic and Physical Data:

The area of the eastern Mediterranean, between Lebanon and Egypt, is an area which links a region that enjoys rainy winters (rain of up to one meter, and even up to one and a half meters annually as in Lebanon), to a region that suffers from an overall lack of rain. The region's location (bordering an extremely arid area) is reflected in the completely dry summers even within the areas that receive winter rains. The category of net moisture (rainfall minus evaporation), divides the area into two types of regions:

- Those in which there is a negative balance (the evapotranspiration is greater than the precipitation) only during the summer (as in the north of Israel, portions of northern Jordan, and all of Lebanon).
- Those, which are utterly dry, in which there is a negative balance both during the summer and usually in the winter as well (southern Israel, most of Jordan, and almost all of Egypt).

The Nile area is a dry environment, but exceptional in that it is not dependent upon water sources within the region. It is an unusual water source first and foremost, because of the amount of water it supplies. The flow of the Nile's waters from southern Egypt (about 55×10^9 cubic meters each year) is some 15 times greater than the total potential amount of water available within the areas of Israel (including the West Bank and the Gaza Strip), Jordan, and Lebanon combined (which have a total population of about one quarter that of Egypt's).

These facts determine several principal characteristics of the demand for irrigation water by the agricultural sector, which is the primary determinant of the region's water requirements.

- Every region in the area needs irrigation during the summer for the agricultural production of deep-rooted vegetation. In the southern areas, irrigation is needed all year for all types of vegetation. The typical annual

quantity of water needed in the "rainy" areas is about a half meter where modern irrigation methods are used, and about a meter of water used in primitive irrigation methods. In the dry areas the amount is roughly doubled.

- The seasonal water surpluses in the north can be transferred to the south and used to help satisfy the regular needs in the south (excluding the Nile area).
- The irrigation of the Nile is an entirely separate issue. The relatively large size of the irrigated Nile area distinguishes it from the other regional areas in that any surpluses in the Nile area, even if they are small for it would be significant for the northern areas. However, the opposite does not hold true: The relatively small seasonal and other surpluses of northern areas are not significant to the Nile area.

B. Economic Factors:

In terms of factors which determine the overall water demands in the region, the following economic ones play a significant role:

- Generally speaking, water (rather than land or other necessary inputs) limits the region's agricultural production capacity. It is the availability of water that determines the magnitude of agricultural production.
- A massive and comprehensive exploitation of the region's main water sources demands government or public initiative and involvement due to the magnitude and cost of such an undertaking. Since most of the water sources are surface ones (and not underground sources which could be exploited with a few solitary drilling sites), they require costly seasonal storage. They are also frequently far from the consumption areas and therefore high costs in transporting the water are incurred.
- The utilization of water in the Nile basin and in the primitive agricultural areas to its north is extensive and wasteful (relative to the existing technological possibilities). Accordingly, the product value of the water (the water's contribution to the agricultural output) is relatively low: about 4-6 cents per cubic meter. In contrast, the utilization of water in the north (in Israel, the OT, Jordan, and Lebanon), is intensive and more

efficient. There, the product value of the water varies between roughly 10 cents per cubic meter (in Jordan and Lebanon) to 20 cents or more per cubic meter (in Israel). These low scale values do not justify the transporting of water to distant or high altitude areas. Transporting water horizontally through pipelines costs some 2 cents per 10 kilometers, while transporting water vertically to higher altitudes costs about 3 cents per 100 meters. Such transportation costs (which are typical for development zones in the region), can only be justified by the higher scales of the water's product values.

Until this point, we have been looking at water use by the agricultural sector, as the primary consumer of water in the region. However, it is not the only consumer. In addition to agriculture, the domestic, municipal, and industrial sectors, as well as hydroelectric plants, have significant water requirements. The municipal and industrial requirements (which comprise a small percentage of Egypt's overall water usage and between 10% - 20% of the other countries totals) are given a higher priority than the agricultural sector's needs. Non-agricultural water usage is assumed to have higher value than agricultural use. It follows that their exploitation costs are higher mainly due to the quality of water required.

Significant hydroelectric utilization is possible in Egypt (because of the magnitude of the Nile's flow) and in Lebanon (because of the appropriate topographical conditions there). The use of water for hydroelectric power in Egypt does not preclude using the same water for irrigation purposes as well. In Lebanon, such usage of water for dual purposes is implemented only seldom and on a piecemeal basis at present.

C. Ideological Factors

Up to this point, we have considered natural and economic factors which affect water consumption in the region. However, factors of another type -- we'll call them "ideological factors" -- also have a significant influence on regional water consumption. This influence stems from the fact that social and other values, beyond the economic ones, are attributed in the region (as in many other places in the world) to irrigated agriculture. Two examples follow:

- Former President of Egypt Anwar Sadat intended to sell Nile waters to Israel (after the conclusion of the Camp David Accords).[1] However, this initiative was criticized by the opposition in Egypt. It claimed that "the holy waters of the Nile should not be transferred to foreigners," even in exchange for appropriate financial compensation.[2]

- In the early 1960s the Arab League decided to prevent the flow of the Jordan River's water from the Golan Heights and Lebanon to Israel by building a canal to divert the water to the Yarmuk River. The Arab League had even begun to implement the diversion plans. Israel's prime minister at the time, Levi Eshkol, announced that such a diversion would be a *causus belli* since "the water is like the blood in our veins." This proclamation must be understood within the Israeli approach to obtaining social goals through irrigation and agriculture as seen in the dispersion of the population within the state of Israel, populating border areas, and the realization of the ideological commitment to 'working the land' and the agricultural way of life.

In summation, the development and exploitation of regional water sources is, first and foremost, allocated to supplying domestic and municipal[3] needs, though most of the water is used for agricultural needs. The demand for irrigation water is influenced by the fact that the scarcity of water is generally the factor that limits agricultural output. Ultimately, agriculture is an economically worthwhile undertaking that has benefits in addition to the economic ones. Among these benefits are "food independence" and the ideological affirmation of "the agricultural way of life."

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[1] This intention was made clear, among other times, during the Begin-Sadat meeting at El-Arish in 1979.

[2] For example, Ibrahim Shukri, head of the opposition Labor party, criticized this proposal on 7.12.80.

[3] "Municipal" here means non-agricultural uses (domestic, industrial, etc.).

3. Developing Water Resources to Satisfy Future Regional Needs:

3.1 The Political Context of the Development of National Water Supplies:

In the region under consideration and in the surrounding areas, the development of national water supply systems has occurred largely in conjunction with major political developments. It is not a coincidence that all the region's states inaugurated their main national water supply systems at about the same time: Israel's National Water Carrier, Jordan's Gohr enterprise, Egypt's Aswan Dam, Lebanon's Litani River plant, and the main dams along the Tigris-Euphrates. That all of these projects were completed during the 1960s is related to the timing of these countries' independence: at roughly the same time in the wake of global developments which stemmed from World War II. The time required, once independence was in place, to decide on, plan, and construct a national water system, resulted in the simultaneous construction of national water supply systems in the region.

The political development of a regional peace settlement could influence the national water supplies of all the states in the region in two ways:

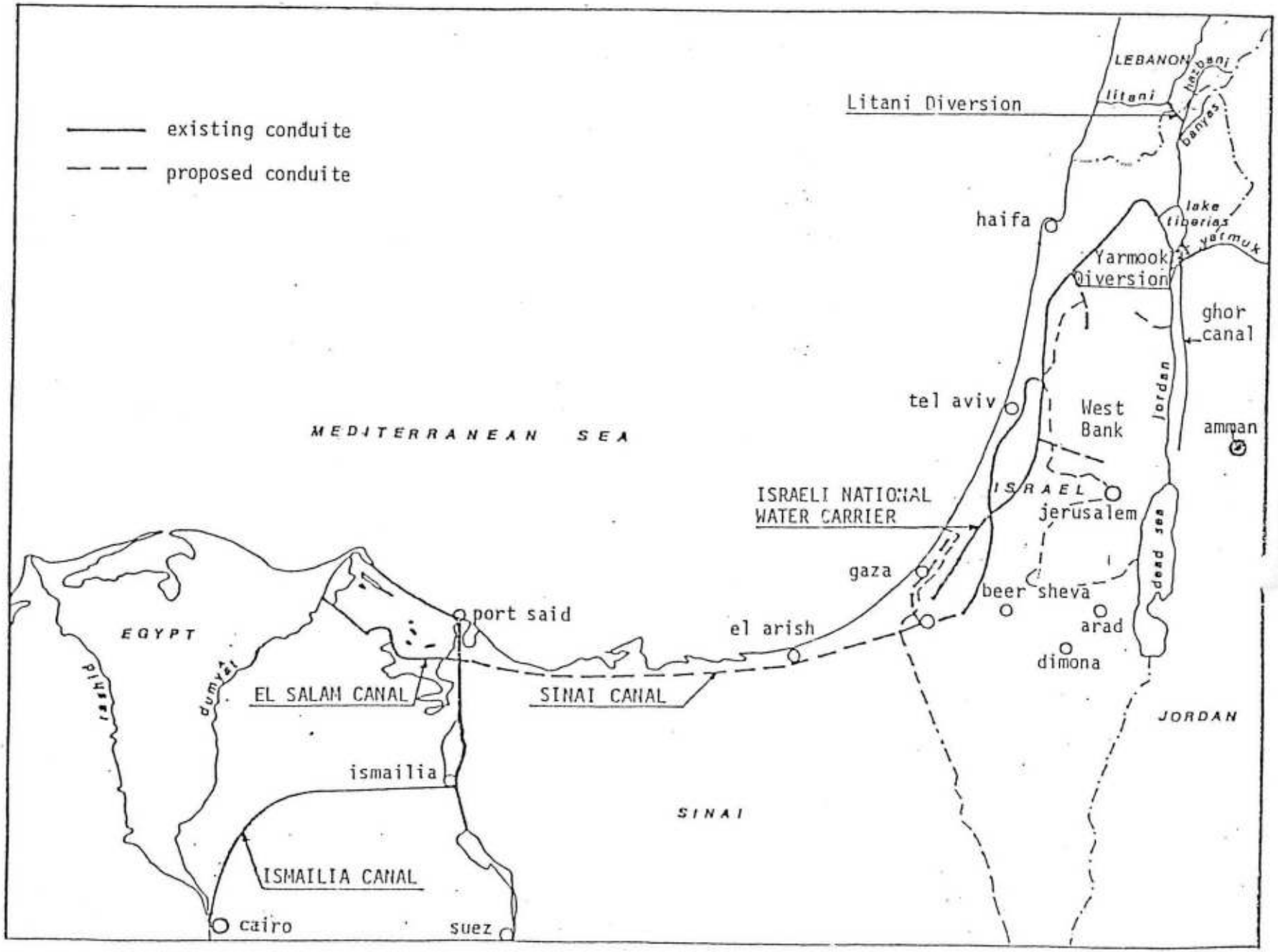
A. It would enable states to improve their water supplies by taking advantage of opportunities which can not be exploited during the present state of war. These would include international projects which, because they necessitate cross-border implementation and cooperation, can not be pursued at the present time.

B. A peace settlement would also facilitate and encompass the resolution of present-day water problems such as water shortages in the West Bank and the Gaza Strip.

3.2 The region's states and peoples threatened by water shortages

Let us now go from a general overview of the regional situation to a more focused analysis of the forecasted water shortages in particular countries. (See Map 1)

Map 1: Regional Main Rivers and Water Conduites



Source: Kally 1986

In the western Levant, water shortages will be experienced in the Gaza Strip, Israel, the West Bank, and Jordan. These shortages are based on the forecasted water demands. The areas will differ in terms of the prices they will be willing to pay for the water, and the amounts of water they will need to satisfy municipal (including domestic and industrial use) and agricultural needs.

The factors which presently determine, and will continue to determine, the magnitude of the water shortages (for both municipal and agricultural use) in these areas are as follows:

A. Each of these four areas: the Gaza Strip, Israel, the West Bank, and Jordan, *has sufficient water supplies from local sources to satisfy the present non-agricultural needs.* In terms of the future (meaning here the first two decades of the next century), this will still hold true for Jordan and Israel, *but not for the Gaza Strip and West Bank. The local and natural water sources in these two areas will not be able to satisfy their municipal demand.*

B. None of these areas has enough water at the present time to satisfy the agricultural demands (and all will have even less in the future). These demands are determined by one or more of the following factors:

- The potential size economic of agricultural production as determined by the availability of arable land, and by the size of the potential working force and export market.
- The present size of the irrigated land.
- The tendency to expand the irrigated agriculture for whatever reason (economic, strategic, or ideological).

The concept of a water shortage as referring to existing agricultural input should raise criticism from an economic perspective. The water shortage as a productive input, can be understood by an economist if it is related to a temporary shortage in the existing system of production. However, when the shortage is defined in relation to theoretical productive capacities on a scale which has never existed, it raises the question of what comprises a "water shortage." Why don't we also speak about the diamond,

gold, and iron "shortages," since these too, were they to be found, could create new areas of production, no less than water?

The answer to this lies in the fact that agricultural activity in this region has values beyond the economic ones as mentioned in the previous section. These values lie in the realms of the aesthetic, ecological, independence in food supply, among others. In any case, a policy by any of the region's states to expand the scope of the agricultural sector so that there is a further strain on the existing water resources, is a realistic scenario that demands consideration, even if it is not based on normal economic considerations.

C. Water used in the municipal sectors has a higher marginal product value than that used in the agricultural sectors. This fact indicates that in times of municipal water shortages, irrigation waters will be reallocated to municipal needs through a reduction of agricultural output. On the other hand, we also forecast situations in which there will be no reduction in the supply of irrigation water, despite municipal water shortages. This stems from the fact that diverting water from agricultural use to municipalities will be delayed for non-economic reasons (social, ideological, and strategic reasons). In any event, such a diversion cannot be *quickly* implemented, even on the basis of considerations of economic efficiency.

Tables 1 and 2 present concrete figures in connection with the anticipated supplies, use of, and shortages of water.

Table 1

Background data on the emerging water shortages in the western Levant[a]

Area/State Data	Israel	Jordan	West Bank[f]	Gaza[f]
Population in millions, 1991 estimates	5.0	3.0	1.0[g]	0.65[g]
"Future" population[b] in millions, assuming 1 million immigrants	7.5	4.3	1.9	1.1
Present Municipal Water Demand in million cubic meters/year	550	110	30	20
Estimated "Future" Municipal Water Demand in million cubic meters/year	950	550	150	70
Present Irrigation Demands in million cubic meters/year	1100[d]	400	100	130
Expected Irrigation Demand in million cubic meters/year according to 3.2B criteria	1400	900	180[e]	130[e]
Potential Suitable Water from Local Resources in million cubic meters/year	1500	1000[c]	120	60

Source: Tahal 1986; updated 1991.

a. According to Kally (1989c), Schwarz (1982) and Tahal (1986).
b. "Future" means 2010 at the earliest.
c. Including 250 million cubic meters of stored Yarmuk winter floods.
d. Before the restrictions of 1991, when the allotment was reduced to 850 million cubic meters per year.
e. Details and source of these demands are presented in chart 3.
f. In the water usage data, no distinction is made between Jewish and Arab needs.
g. According to the 1991 yearbook of the Israeli Bureau of Statistics, at the end of 1990 the population in the West Bank stood at .96 million and in Gaza at .64 million people.

The water shortages that can be anticipated on the basis of the data in Table 1 are detailed in Table 2.

Table 2:
The Expected Water Shortages in the Region
in Million Cubic Meters per Year

	Formula/Source	Israel	Jordan	West Bank	Gaza Strip
(1) Estimated Municipal Water Demand	Table 1	950	550	150	70
(2) Ind. Resources of Suitable Water	Table 1	1500	1000*	120	60
(3) Available for Agr. Use after Satisfying Municipal Needs	2-1	550	450	-30	-10
(4) Expected Demand for Irrigation	Table 1	1400	900	180	130
(5) Possible Supply for Irrigation from reclaimed Drainage	50% of 1	475	275	75	35
(6) Expected Water Shortage	(4) -(3) - (5)	375	175	135	105
(7) Expected Municipal Water Shortage	(2)-(1) if <0	—	—	30	10

* Assuming that Jordan fully utilizes its share of the Yarmuk River waters (which necessitates the storing of winter floods).

As was presented in the previous table, all four geographical areas under consideration can expect water shortages. However, the most serious shortages, which are characterized by municipal as well as agricultural deficits, are expected only in the West Bank and Gaza.

Those who see the West Bank and the Gaza Strip (henceforth the "Territories") as independent geo-political units, and not as part of Jordan or Israel, will discern there the threat of significant potential water shortage. All the countries in the region, Israel, Lebanon, Syria, Jordan, and Egypt, are partly arid. However they all have control over sufficient water resources to satisfy all their non-agricultural water demands and a significant part of the agricultural needs for the foreseeable future. The Territories differ in that their natural water sources cannot satisfy even these non-agricultural needs.

The potential water shortage in the Gaza Strip results from the population density and the agricultural uses, while the shortage in the West Bank is caused by the fact that most of the water resources which they could have been physically utilized have already been exploited (the aquifers supplying Israel and the southern Jordan River are used by Israel and Jordan). This situation has been caused mainly by natural factors. These aquifers that are located in the West Bank drain for the most part into Israeli regions, such as the Yarkon, Tanninim, and Charod Rivers, and the Beit Sha'an Springs.

These sources have already been completely exploited by Israel since the 1950s, and therefore any Palestinian claim regarding them will be dismissed, both by the water users, and according to the precepts of international law. International law, regarding water rights, gives priority to those who are presently using and have historically used the resources, over new claims. Therefore, the rights of the residents of the West Bank regarding the Yarkon-Tanninim aquifer has no more standing in international law than, for example, the rights of Ethiopians on the waters of the Egyptian Nile. The claim that the rain which supplies the aforementioned Israeli and Egyptian sources falls elsewhere (in the West Bank and Ethiopia, respectively) has no validity in international law on water rights.

4. Possible solutions:

4.1 General

Solutions based on regional water resources are to be considered in the following. These solutions are divided into 2 categories:

A. Local solutions (within the boundaries of Israel and the Territories)
A.1 The status quo regarding control over water sources
A.2 Transporting or selling Israeli water to the Territories
B. Importing solutions
B.1 Desalination of sea water and transporting it to the Territories
B.2 Importing water from neighboring countries

These solutions are to be considered below in the context of the relevant engineering, economic, and political facts.

4.2 Status Quo

This alternative initially satisfies municipal and agricultural needs in the short run, but will obviously be unable to satisfy even municipal needs in the future. This situation is completely unstable and will create immediate tensions and demands regarding the regions water sources (particularly Israel's "Yarkon-Tanninim" aquifer). These claims have no hope of being satisfactorily addressed, as explained in the previous section. This "solution" is defective, though politically and functionally feasible.

4.3 Transferring Israeli Waters to the Territories

In light of the water problems in Israel and the need to severely curtail the amounts of water used for agriculture (both to adapt to the present potentials and to meet the increasing municipal needs), this will not be a practical solution.

4.4 Importing Solutions vs. Local Solutions

In contrast to the inability of the local resources to provide a solution for the water shortage problems, importing schemes provide viable alternatives. The relevant factors which will ensure the effectiveness of such a solution follow:

A. These solutions can provide a supply sufficient to satisfy the present and future water demands, and can thereby help to attenuate the severity of the conflict. (The implementation of such a solution is impossible with regard to land resources, another essential component of the conflict.) This approach is similar to the one adopted in the Indian-Pakistani conflict over the Hindus waters. A joint plant produced in the 1950s more water than the total amount of water that was under dispute and thereby resolved the conflict.

B. Importing schemes entail a significant initial investment which is high for the states involved. However, the international interest in a regional peace settlement, should guarantee that this type of investment will be forthcoming from the international community. There are precedents for such international contributions both in the region and for water projects in general. The aforementioned Indian-Pakistani example is instructive, as the construction of the plant was financed on favorable financial terms by many states which shared an interest in peaceful relations between the two states.

Another precedent is, the transfer of Israeli airfields from the Sinai to the Negev (as part of the Egyptian-Israeli peace agreement), and the clearing of the Suez Canal were both financed internationally in order to facilitate the successful implementation of the Egyptian-Israeli peace treaty.

4.5 Man-Made Water Supplies

Within this category, a sea water desalination plant located in the Gaza Strip is a possible option. This plant could also supply water to the West Bank and more efficiently if done through an exchange: Supplying water to the Negev from the Gaza plant in return for the supply of Israeli

water to the West Bank from the northern part of the national water carrier system. Or an agreement could be reached so that the residents of the West Bank could draw water from shared sources. In such a scenario, the Gaza desalination plant would be credited for the transporting costs saved by the Israelis (from the north to the Negev). It will also be possible to add a processing unit for the desalination of brackish ground water (which is a cheaper process than desalinating sea water).

It will also be possible to establish a dual purpose plant which will produce electricity and fresh water through a "multiple stage flush (MSF) desalination process. (The optimal output proportion for such a plant is about 8 megawatts per million cubic meter per year, which may be too much for the electricity demands of the Territories.) However, we should assume that a single purpose reverse osmosis plant will be constructed (see section 7).

The main advantage of this solution is that the plant would be controlled exclusively by the residents of the Territories, freeing them from any dependence on foreign water sources. The basic drawback to this plan is the substantial initial investment required and the cost of the water. The anticipated water cost is about 45 to 60[1] cents per cubic meter, assuming that the initial capital investment is 6% to 12%, respectively. This results in a fixed subsidy for the plant's operation costs (in addition to the initial investment subsidies).

4.6 Importing the Water from Foreign Sources

Such a solution could utilize the Nile, Yarmuk, and perhaps the Litani rivers (if Lebanon shows a willingness to sell water to the Territories or to Jordan). This solution is based upon the following technical and political considerations:

A. It is feasible, both economically and technically, to extend Egypt's supply system in the Sinai (which was designed to bring Nile water to the Sinai), and thus satisfy the Gaza Strip's water needs from the Nile. Such a

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[1] After the added benefit resulting from the "Exchange Supply" (see section 7).

solution will probably not encounter any political difficulties which cannot be overcome.

B. According to Jordanian plans, water supply for the West Bank was designated to be provided by the Yarmuk River by means of the Western Branch of the Gohr water supply system. This plan can certainly be revived today within a comprehensive plan for the full exploitation of the Yarmuk river. Implementation of such a comprehensive utilization of this water is feasible provided the Yarmouk winter floods are stored.

C. The purchase and transport of Litani waters (by means of diversion to the water shed of Lake Tiberias through the Hasbani River or Ayun River) to the West Bank is economically and technically feasible (not taking into account political considerations).[2] The advantage of this solution lies in the fact that there is no costly initial investment and no need to permanently subsidize the plant's operation costs. Its drawback is that it involves more regional participation and entails a permanent dependence on foreign sources. The regional nature of this solution necessitates regional conditions only possible under a region-wide peace.

It may also be possible to transport Nile waters to the West Bank (in addition to Gaza). However, supplying the West Bank with Nile waters is economically efficient only if it is done in conjunction with the Israeli national water carrier. For example, the Nile waters intended for the West Bank would not actually supply the West Bank, but instead the Negev. In exchange the Israeli national water carrier would supply the West Bank. This type of exchange obviates the need to transport water through the national water carrier to the Negev. There would thus be significant savings, though it is more complicated from a political standpoint.

5. Importation Schemes to Supply the West Bank and Gaza Strip

5.1 General

The following are the main background details that will influence the nature of the water supply to the Territories:

A. A foreign/Israeli enterprise to supply the Territories with water can only be realized within the framework of a regional settlement. One of the components of such a settlement would be the independence or autonomy of some type for the Territories. One of the expected results in the demographic sphere will be, particularly in the West Bank, a reduction or cessation of the net emigration which exists today. Instead, there will be a net immigration and a rise in the present rate of population growth (until a saturation point is reached because of natural and economic factors).

B. The population growth in the Territories cannot be based on agriculture, but, particularly because of the water and land constraints, must be based on industry and services (like the tourist industry). Still there will be a strong demand for irrigation water because of the traditional agrarian lifestyle of the Territories. The available suitable land will allow for the expansion of agriculture up to a level of self-sufficiency in growing fruits and vegetables for the local population and also some export to the Gulf states, Iran, and Europe.

C. The West Bank has agricultural areas at altitudes of 200 meters to 700+ meters. Transporting waters to these regions for irrigation is economically inefficient when one takes into account the sources altitudes. It is therefore reasonable to assume that a plan for irrigating only the low-lying areas is preferable.

D. The Nile is the preferred foreign source for supplying the Gaza Strip with water because of physical and political reasons. It is, however, a less obvious choice for supplying the West Bank. For the West Bank, the Yarmuk, and perhaps the Litani, are preferable sources. These sources should first be diverted to Lake Tiberias, and from there would meet the needs of the West Bank's populace (Kally, 1989 a and b).

E. The total amount of irrigated land in the Territories is ten thousand hectars in the West Bank and fifteen thousand in the Gaza Strip. The total suitable area for irrigation (not including small plots under a hundred hectars) is about fifty-three thousand hectars in the West Bank (including the high altitude areas which have little chance of being irrigated) and about twenty thousand hectars in the Gaza Strip.

5.2 Expected Water Demand in the Territories

The water demands here refer to the planning time horizon of the first decades of the next century. For the purposes of this paper, the Territories are divided into water supply districts (see Map 2):

- Gaza Strip
- Samaria (Jenin district and Nablus)
- Judea (Ramallah district and Bethlehem)
- Hebron district
- Jericho district

Future water demands, both agricultural and non-agricultural in the Territories are based on updated figures (Kally, 1989 a).

5.3 Non-Agricultural Demand

The population in the territories, which stood at 1.7 million at the end of 1991, should reach between 2 and 3 million people early in the next century[1] (one-third of this in the Gaza Strip).[2]

The non-agricultural water demands will be about 80 cubic meters annually per person in the West Bank, and about 65 in the Gaza Strip. (Presently, the figure is about 30 cubic meters annually per person in the territories and about 110 in Israel).

5.4 Water Demand for Irrigation

The estimated water demand for the agricultural sector is based on the following figures and assumptions:

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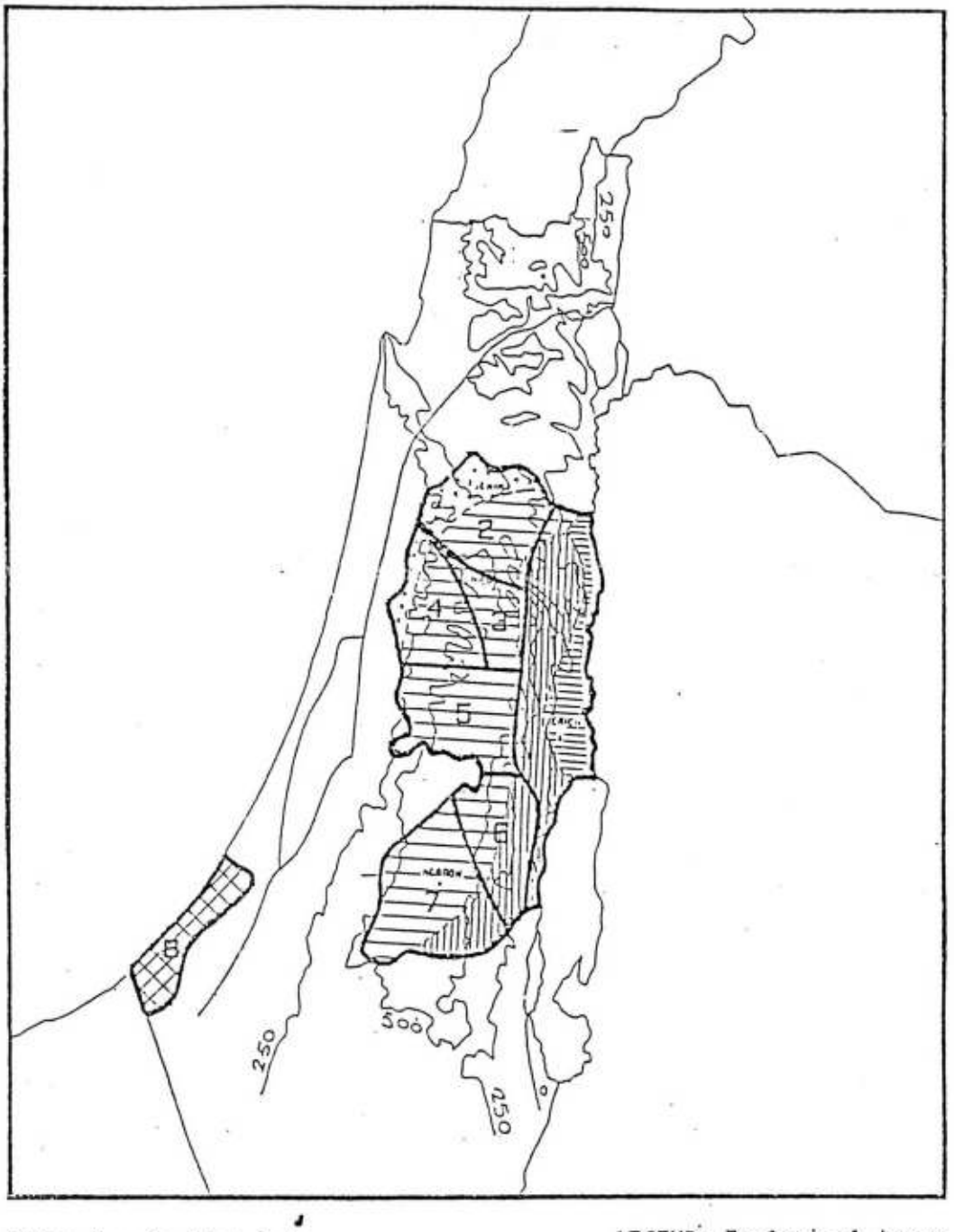
[1] Henceforth, figures which appear in the text and are not footnoted are taken from Tahal, 1986.

[2] According to Bahiri (1983), in the beginning of the next century the population will be some 2 million if the existing political situation continues and about 3 million in the event of political independence, which will bring about immigration into the territories.

Map 2: Water Supply Districts on Ecological Areas Background



Water Supply Districts

1. Jericho District
2. Samaria - Jenin District
3. Samaria - Nablus District
4. Samaria - Tul Karem District
5. Judea - Ramallah District
6. Judea - Bethlehem District
7. Hebron District
8. Gaza Strip

LEGEND: Ecological Areas

Jenin Area –

Jordan Valley –

Eastern Foothills –

Upland –

Costal Plain (Gasa area only) –

source: Kally 1986.

A. In the West Bank there is a total of fifty thousand hectars suitable for irrigation (out of which ten thousand hectars presently being irrigated).

B. In the Gaza Strip there is approximately twenty thousand hectars suitable for irrigation (not including small plots under a hundred hectars). There is presently fifteen thousand hectars being irrigated and only about eight thousand hectars which can be irrigated without overpumping non-renewable water.

C. The proportion of agricultural crops will be similar to that in Israel today: one-third perennial crops and two-thirds annual crops, such as vegetables. This does not include the Jordan Valley and Gaza Strip, where the ratio will be fifty-fifty.

D. The efficiency of the irrigation will be similar to that in Israel, though not in Gaza which has a deep-rooted tradition of over irrigating. As is detailed in chart 3, water requirements will range between 500 cubic millimeters per year in the mountain range, to 1050 cubic millimeters per year in the valley. The difference is caused mainly by the perennial crops. The water needs of the annual crops is uniformly between 400 and 500 cubic millimeters per year (since in the dry areas they will concentrate their crops in the winter and in rainy areas, during the summer). The different ecological areas which determine the differing water needs in the region are presented in Map 1.

E. The demand of agricultural production will not limit the full exploitation of the land suitable for irrigation. The supply of fruits and vegetables in the Territories will exceed the local demand (assuming that the yields reach the Israeli levels, which should happen rather quickly). The demand for the agricultural produce in the Gulf states, Iran and other foreign countries, would absorb the expected surplus.

Details of the agricultural demand for water are presented in Table 3.

Table 3:

Division of Potential Water Demand for Irrigation According to Ecological Regions and Water Supply Districts

	Ecological Region	South Coastal Strip	North Coastal Plain	West Bank Heights	Eastern Slopes	Jordan Valley	Total	Without West Bank Heights & Eastern Slopes
Water Supply District	Av. Water Demand mm/Dunam	650	600	500	700	1050	--	--
Gaza	Area[a]	200	--	–	–	–	200	200
	Water Dmnd	130	–	–	–	–	'30	130
Samaria Region[b]	Area	–	100	128	61	18	307	118
	Water Dmnd	–	60	64	42	19	185	79
Judea Region[c]	Area	–	–	52	4	–	56	15(*)
	Water Dmnd	–	–	26	3	–	29	8
Hebron Region	Area	–	–	100	–	–	100	24(*)
	Water Dmnd	–	–	50	–	–	50	12
Jericho Region	Area	–	–	–	–	77	77	77
	Water Dmnd	–	–	–	–	81	81	81
Total	Area	200	100	280	65	95	740	434
	Water Dmnd	130	60	140	45	100	475	310

a In thousands of Dunams = Hundreds of Hectars and million cubic meters per year.
b Including the Nablus, Jenin, and Tulkarem districts.
c Including the Ramallah and Bethlehem districts.

(*) Because of this region's altitude, it will not be economical to import water. The figures given are those of the amount of water it can get from local reclaimed sewage water.

The agricultural (table 3) and the non-agricultural demands (table 2) will result in the shortages listed in table 2 (135 cubic meters per year in the West Bank and 105 million cubic meters per year in the Gaza Strip). They are detailed again in the following table.

Table 4:

Water Demands and Their Sources (million cubic meters per year)

District	Present Usage	Projected Demand	Local Natural Source	Reclaimed Sewage	To be supplied by imported water
Gaza	150	200	60	35	105
West Bank	130	330	120	75	135
Total	280	530	180	110	240

6. Importing Water to the Territories

6.1 General

The Nile, Yarmuk, and Litani rivers are feasible water sources for a local plant from both an economic and a technical standpoint. A regional peace settlement would provide the necessary political environment for the implementation of such plans. Any plan of this type entails sacrifice of a portion of water, a national resource, by the supplying country. As such, these proposals may be opposed by the exporter because of principled opposition to the removal of a natural resource, and because of the fear of the importer that the "tap will be shut off." The methods of transporting water from these sources is surveyed in Kally, 1989 a and Kally, 1989 b.

6.2 Political Background

The use of any of these water sources has political implications which are to be surveyed below.

A. The Nile

The use of the Nile water to supply the Territories entails sacrificing a small amount of water (the quantity needed by the Gaza Strip amounts to roughly 0.2% of the Nile's waters) in exchange for financial compensation and political benefits.

Supplying Israel with Nile water has already been considered by Egypt. During the Egyptian-Israeli honeymoon in the wake of the Camp David Accords, Anwar Sadat had committed himself to supplying Israel with Nile waters. However, this initiative was bitterly criticized in the Egyptian press and denounced publicly (particularly by opposition groups). It is clear that the public opposition to such a plan may be a factor even in the face of a government decision which approves of such a proposal.

On the other hand, supplying the Territories with Nile waters has not yet been considered in Egypt. The nature of the opposition to supplying Israel with water (which was based more upon emotional opposition than on a desire to keep the water) does not preclude the possibility of public concensus to supplying the Territories. In any case, it seems that for such a plan to be supported in Egypt, the Egyptians must see it as helping the Palestinians, it must be in the framework of a regional peace (which serves Egyptian interests), and Egypt must benefit from appropriate material compensation.

B. The Yarmuk

The diversion of the Yarmuk (see material presented in publication 7) could serve as a suitable water supply from a technical standpoint. Under conditions of peace, there are also social and political factors which would bolster the viability of this alternative. Some of the relevant facts include:

1. Prior to the Six-Day War, plans were drawn up to supply the western part of the Jordan valley in the West Bank (which was part of Jordan at the time) with Yarmuk waters. More recent Jordanian plans do not contain such provisions.
2. As there is no other feasible long-range solution to Jordan's own water shortage problems, Jordan has considerable economic and social incentives to implement a plan to store Yarmuk water in Lake Tiberias. In the context of a regional peace, these incentives could convince Jordan to implement such a scheme.

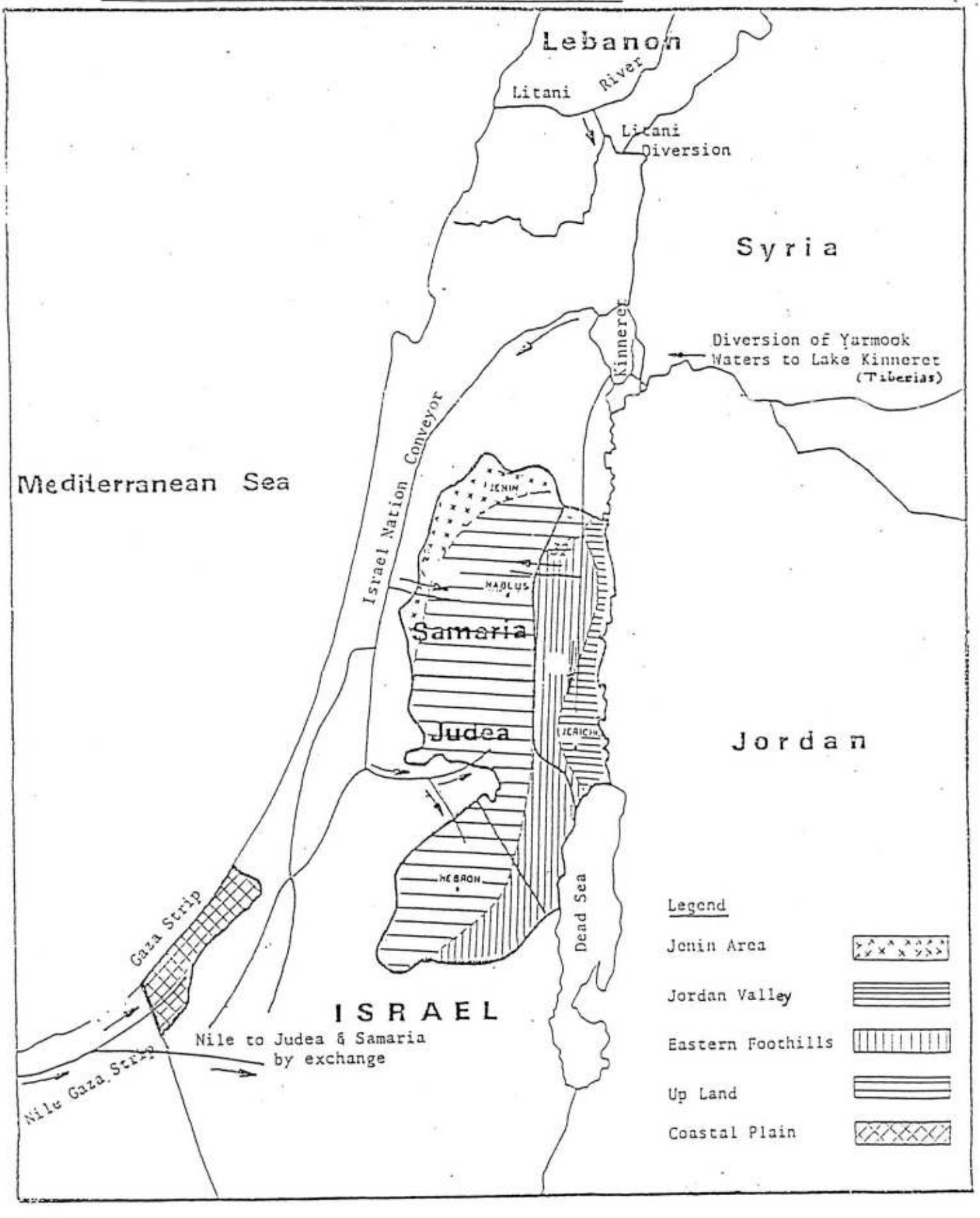
C. Supplying Litani Water to the Territories

1. Agreement by the Lebanese government to sell Litani water would likely encounter opposition by local vested interests (such as those in the electrical and agricultural sectors).
2. In Lebanon, as in Egypt, there may well be a public outcry against the export of water, a natural resource. However, both payment for the water and the potential for a greater supply of electricity than Lebanon could produce on its own (since the flow down into the Lake Tiberias generates greater hydroelectric output than the flow into the Mediterranean) would be significant incentives for the Lebanese.
3. There have been previous plans to sell Lebanese/Syrian water to Jordan. For instance, the Syrian Diversion Canal Plan calls for transporting water from the sources of the Jordan river to the kingdom of Jordan by way of the Golan Heights. Though this plan could not be implemented since it was based primarily on using Israeli water, the essence of the plan (with Lebanese water) could be revived in the context of a regional peace.

6.3 The Components of the Project

The components of the different projects, based on the different possible water sources (see map 3), are as follows:

Map 3: Imported Water Supply - Sources and Destinations



source: Kally 1986.

A. Supplying the Gaza Strip from the Nile

1. Expansion of Egypt's Delta-Sinai system and its adaptation to transfer a larger amount of water.
2. Extension of Egypt's Delta-Sinai System and construction of a conveyance system (canal) that would pass through the Gaza Strip. This plan would ensure a direct supply during the summer and would artificially replenish of the aquifers during the winter months.

It is also technically possible to supply Nile waters to the West Bank. However, this is economically feasible only through an exchange system with the Israeli water system in which Israel supplies the West Bank and the Nile supplies the Negev. Despite the plan's economic viability, since the costs of transporting the water are reduced by cutting the distances from the sources to the distribution areas, the political complications make it a less reliable option.

B. Exchange Supply from the Nile

The implementation of this plan would entail:

3. Extending the Delta-Sinai system (as in section 1).
4. Implementation of a system of distribution from the Delta-Sinai system to central storage/reservoir points in the Negev's supply system. This plan would include installations to improve the quality of the Nile waters to levels suitable for irrigation (though not drinking) in Israel.
5. Distribution of water from the Israeli supply system to the central reservoirs in the West Bank.
6. Subterranean storage facilities (wells and well attachments) that will be used to store winter waters drawn from Lake Tiberias to supply the West Bank during the summer.

C. The Yarmuk

The plan for supplying Yarmuk water to the West Bank includes the following components:

7. Proportional cost-sharing (between the involved users) of building a system for diverting the Yarmuk waters to Lake Tiberias (Kineret).
8. Pumping water from Lake Tiberias to the Israeli water system (including joint participation in pumping installations and use of power supply)
9. Distribution from the Israeli system to targeted areas in the West Bank.
10. The establishment of a transport system from Lake Tiberias southward through the western Jordan Valley. (It is possible that the Gohr Canal could be used to transport water southward.)
11. Distribution from this system to various consumptions points in the Jericho subdistrict.

D. The Litani River

In case of Lebanese agreement to sell Litani water to the West Bank, this system could serve as a partial substitute for the Yarmuk scheme. Components of this plan include:

12. Diversion from the Litani to the Ayun river
13. Pumping from Lake Tiberias (as in 8).
14. A conveyance system from Lake Tiberias southward (as in 10).
15. Subsystems to supply the major consumption points in the Jericho subdistrict (as in 11).

The capacity of the various installations will be determined by the supply needs of the peak month (August) which accounts for 15% of the total annual supply.

Of the four plans presented, we will now consider the two most feasible ones: supplying Nile water to the Gaza Strip and supplying Yarmuk water to the West Bank. (The sale of Litani or Nile water to the West Bank will not be considered).

6.4 Project Investment and Water Cost

The investment in the various components of the project (detailed in Kally, 1989 a and updated here to 1991 prices) would total about $366 million (based on irrigating only the lower areas in the West Bank). The cost of the water was calculated to take into account, in addition to the return of the initial capital investment, the following:

Water Cost at the Source

The water imported from Egypt and Lebanon have a cost component of the value of the water at the source. The estimated source value of the Lebanese water is much higher than the Egyptian one, due to the higher value of Lebanese water's marginal product. This cost component is accounted for despite the fact that both countries will have some water surplus for a few years to come (during which time the marginal product value of the transferred water is zero).

Energy

This has been estimated at 7 cents per kilowatt hour. The economic figures for the enterprise are detailed in tables 5 and 6.

Table 5:
Project's Supply (in million cubic meters per year) and Investment Costs (in millions of dollars)

Source	Gaza Strip	West Bank
Nile	Supply 105	–
	Investment 142	–
Yarmuk	–	Supply 135
	–	Investment 224

Table 6:

Water Cost Broken Down by Component (in cents per cubic meter)

Source	Cost at Source	Operation	Energy	Investment		Total	
				6% interest	12% interest	6% interest	12% interest
Nile	4.5	3.5	5.2	8.5	16.2	21.7	29.4
Yarmuk	—	1.6	10.7	10.5	19.9	22.8	32.2

While these costs are quite high, the operational costs, which are not connected to investment, are in line with those in the region. In the event of a significant investment subsidy, the whole enterprise would be feasible.

7. Supplying Desalinated Water

7.1 The supply of desalinated seawater as an alternative to water importation.

Water desalination schemes have already been considered both as a regional supply and exclusively for the Gaza Strip as well. In the beginning of 1966 a "multiple stage flash" (msf) installation was planned (see 7.2, Desalination Techniques) by an American-Israeli team, with the goal of finding a solution for the water shortages in Israel and in the Territories. The plan was updated and worked out in detail in 1968 as a dual purpose facility for supplying energy (300 MW) and water, supplying about 150,00 cubic meters a day.

This plan was shelved primarily because of the high cost of the water. With a capital cost of 11.7 percent and a power cost of 4.5 cents per kwh in 1988 prices, the cost of the water reached about 70 cents per cubic meter, while the agricultural sector's marginal product value was only 15 to 30 cents per cubic meter.

There were expectations of a technological breakthrough in water desalination technology during the seventies and eighties. This did not

happen in the MSF technology. The updated study of this plan (see Tahal, 1986) concluded that water costs today would be the same as the costs estimated in the sixties (using fixed prices and the same estimates). There were, however, signs of technological advances with the reverse osmosis method (see section 7.2).

There are a number of options with regard to certain elements of a desalination plant:

- The location of the plant
- Desalination technique
- The annual amount supplied
- The role of such a plant in supplying the Territories
- The method of supply: Directly to the consumers or through an exchange with the Israeli supply system

The option presented here is based on the following:

A. Locating the water desalination plant in the Gaza Strip.
B. The annual supply will be the same as that specified in the aforementioned project: 240 million cubic meters per year.
C. The water will be supplied directly to the Gaza Strip and through an exchange with the Israeli supply system to the West Bank.
D. The installation will use the reverse osmosis method (detailed in the next section).

7.2 Desalination Techniques

There are two relatively low-cost and established desalination alternatives which are technologically suitable for the purposes.

A. A Multiple Stage Flash installation which serves the dual purpose of supplying water and electricity.
B. Reverse Osmosis, which pressures the water through a salt-impermeable membrane. The basic technical and economic data of the two methods are presented in table 7 (see also Tahal, 1986 and Kally, 1989 a).

Table 7:

Features of Water Desalination Systems for a Plant Treating 40,000 Cubic Meters per Hour

Method	Dual Purpose MSF*		Reverse Osmosis	
	Existing Technology	Outlook for 2000	Existing Technology	Outlook for 2000
Feature				
Time span between decision and operation	8 years		6 years	
Potential for Improvement	Limited		Exists, particularly with the membranes	
# of operating hours in year	~5000 (depending on electricity demand)		~8000 optimally[3]	
Area Needed for the Plant (hectares)	~20		~2	
Chances of Staged Construction	Low		High	
Initial Investment[b]	620	515	570	420
Energy Needs (in kwh per cubic meter)	7.0	5.8	4.2	3.8
Resulting Salinity[c]	50	50	500	500

* Water purification and electrical plant.

(a) But because of agricultural consumption, demand may drop to about 6000.

(b) In Millions of Dollars per Year (1991 prices).

(c) In parts per million of total dissolved solids.

The basis for deciding which of the methods is preferable includes consideration of the following issues:

- Cost of the water
- The possibility of staged investment.
- Flexibility regarding power production.
- The resulting salinity

The advantages of reverse osmosis in regard to the first three issues and the fact that the resulting salinity, though higher than MSF, is not problematic, make it the preferred option.

7.3 Cost of Supplied Water

Considering the ways the desalinated water is to be incorporated in the supply system (see section 7.1), the necessary investment will be:

• Investment in the desalination facility	$420 million
• Investment in storing and conveyance costs	$130 million
• Total	$550 million

The cost of the water in cents per cubic meter will be:

Interest rate	6% interest	12% interest
Initial investment	14.5	27.5
Energy Cost (4.5 KW/cubic meter)	31.5	31.5
Saving on Pumping in the Israeli conveyance system		
(see section 4.6)	-9.0	-9.0
Operation Cost	9.0	9.0
Total	59.0	46.0

7.4 Appraisal of the Desalination Option

The evaluation of this alternative is based on the following considerations:

A. A desalination facility which will supply a significant amount of water satisfying the relevant demand (240 million cubic meters per year in the previous example; however, a "significant amount" would also be 150 or even 100 million cubic meters per year), would be very large in any scale and consequently subject to risks regarding the construction of the plant, as well as the final cost.

B. Water from the water plant will be more expensive than imported water by about 25 to 30 cents per cubic meter. Even the operational costs will result in water that is too expensive for irrigation and will need a permanent subsidy.

C. This plan has the advantage of not being dependent upon the good will of any foreign country.

In view of the data presented the importation option appears preferable.

8. Conclusions

The West Bank and the Gaza Strip will, most likely, experience water shortages of some one-quarter billion cubic meters per year by the beginning of the next century. If the water demand is not supplied by external sources, the shortages will probably cause the following problems:

A. A freeze and subsequent reduction of irrigation (from the present usage of one hundred million cubic meters per year) will have to be imposed in the West Bank to provide water for the higher priority non-agricultural (domestic, industrial, and municipal) needs.

B. In the Gaza Strip, similar shortages will materialize even faster unless the current over-pumping of underground aquifers is curtailed and stopped.

C. These problems could create more friction and political conflicts between the residents in the Territories and the state of Israel. In the West Bank the problems will stem from the fact that the local residents have direct access to the aquifers which supply the Israeli water system. In the Gaza Strip, conflicts could emerge because Israel will be using water sources (Wadi Bsor) which could also supply water to Gaza.

Palestinian claims to water presently under Israeli control – particularly the Yarkon-Tanninim aquifer – will not be practical because of Israel's own water shortages and because they will not have any standing in international law (due to the legal preference for existing and historical consumption over new claims). The resolution of the Palestinian water problem must therefore be based on an importation scheme which would be facilitated by a regional peace agreement. Thus such a project is contingent upon, and can also strengthen, a comprehensive peace.

It is technically possible to supply water to the West Bank and the Gaza Strip from external sources such as the Nile, Litani, and Yarmuk rivers, or by means of a water desalination plan.

While the desalination alternative has the advantage of not depending on the good will of any foreign government (which controls the water sources), any such scheme will necessitate reliance on a substantial permanent subsidy to cover the operating costs (since these costs are higher than the marginal product value of irrigation water. Moreover, these alternatives entail risks which stem from the complexity of this technology, in view of the large quantities of water which will be needed.

Each external water source proposed is subject to certain drawbacks and constraints regarding availability, cost, and political feasibility. The supply destinations are also limited by the topographical features of the consumption areas in question. Transporting water to high altitude areas (in the Nablus, Bethlehem, Ramallah, and Hebron districts) will be too costly for agricultural purposes. However, transporting water for agricultural uses in the low-lying areas (in the Gaza Strip, the lower West Bank, and in the Jericho region) will probably be cost-effective.

In light of all these considerations, I propose the project features that follow as a solution to the Palestinian water problem, in the context of peace.

- Irrigation water will only be supplied to low-lying areas in the Jordan Valley, the Gaza Strip, and in the Jenin, Tulkarem, and Nablus districts. The supply will be 240 million cubic meters per year at an investment cost of $366 million.
- Nile water will supply the Gaza Strip, and Yarmuk water (whose supply depends upon the storage of the river's winter floods) will supply the West Bank.
- If this importation scheme encounters difficulties and cannot supply all the needed water, a desalination scheme will have to be implemented to make up the shortfall.
- Since the demand for the project's water supply will develop gradually, it will be preferable to stage the investment and implementation of the project.

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